FINDING OF NO SIGNIFICANT IMPACT
ENVIRONMENTAL ASSESSMENT (EA)
IMPLEMENTATION OF THE INSTALLATION DEVELOPMENT PLAN (IDP)
EDWARDS AFB, CALIFORNIA

AGENCY: Department of the Air Force, Air Force Materiel Command (AFMC), Air Force Test Center, 412th Test Wing, 412th Civil Engineer Group, Environmental Management Division, Edwards AFB, California

BACKGROUND: This EA evaluates the potential environmental impacts associated with implementation of the IDP at Edwards AFB, California. The IDP is a planning tool for leadership and decision makers of the 412th Test Wing, AFMC and United States Air Force in making good development decisions in support of future commitments that will support the mission at Edwards AFB. In order to test, evaluate and develop weapon systems to deliver superior capability to the Nation's combat forces, the installation requires a guide for future installation development decisions. The IDP outlines future requirements that will enhance mission capability for the entire 412th Test Wing.

The underlying need for the IDP is to support the Edwards AFB test mission. The IDP serves as the planning tool for demolition, construction and modification of facilities and infrastructure that have been identified by Edwards AFB as critical in supporting current and projected mission needs. To that end, the overall purpose of the IDP is to identify and address major development projects as well as major repair and maintenance projects that would support the mission statement by optimizing operational efficiencies and resolving incompatible land use issues at Edwards AFB. The EA analyzes the potential impacts of implementing the IDP over the next 10 years or so. This was analyzed as a High Intensity Development Alternative. Two additional alternatives, including the No Action Alternative were analyzed as well.

ALTERNATIVE 1 – HIGH INTENSITY DEVELOPMENT ALTERNATIVE: The IDP lays out long-term, maximum buildout in nine Planning Districts although it is unlikely that all identified projects would be implemented in the next 5 to 10 years, given the uncertainties of funding and evolving mission requirements. However, in order to provide a worst-case environmental analysis that allows for flexibility in the types and numbers of projects that may be undertaken, a high-intensity development alternative is proposed in which a select list of projects (or types of projects) that are most likely to occur or represent the types of development that could occur in each Planning District have been selected for inclusion in the environmental analysis. The types of projects that may be considered include construction of new facility space, demolition of building space, construction of aircraft parking/ramp space, upgrading or construction of utilities and roads, and construction of facility perimeter fencing. It is assumed that no significant increases in personnel would be required and no projects are proposed in floodplain areas.

ALTERNATIVE 2 – BASIC MAINTENANCE ALTERNATIVE: With Alternative 2, no new structures or facilities would be built. It would consist of maintaining existing facilities so

that they are kept operational to prevent mission degradation. This could include renovation or repurposing of existing structures to configure facilities to meet ever changing missions and further enhance planning district efficiency. It may also include consolidation of functional areas and moving people around according to function or organization.

ALTERNATIVE 3 – NO-ACTION ALTERNATIVE: The No Action Alternative would be no change from current practices (status quo), or continuing with the present course of action until that action has changed. On average, over the past 10 years, approximately 2 to 3 major projects have been constructed at Edwards AFB each year. Under the No Action Alternative, this minimal level of development would continue and future installation development projects would continue to be evaluated on an individual basis without regard to planning district efficiency, current capacity or functionality.

SUMMARY OF ENVIRONMENTAL EFFECTS FOR THE ALTERNATIVES:

Air Quality and Greenhouse Gases. Construction and operational emissions would be well below significance thresholds and would not be significant. Incorporation of minimization measures (MM), MM AIR-1 through MM AIR-13 to minimize fugitive dust emissions and to ensure compliance with state off-road regulations would further reduce air quality impacts and greenhouse gas emissions.

Cultural Resources. Demolition and construction, and other activities associated with Alternative 1 could affect cultural resources at Edwards AFB. In areas not previously surveyed, a cultural resources survey should be performed prior to the onset of the construction, demolition, installation, or enlargement, with Formal evaluation conducted as warranted. While avoidance is the preferred treatment for cultural resources, avoidance is not always feasible. In such situations, a cultural resources monitor may be present for the duration of the ground disturbance or renovations. However, with incorporation of MM CUL-1, potential impacts to cultural resources would be reduced to a less than significant level.

Geology and Soils. Most development would occur in areas adjacent to existing development or in areas previously disturbed. Any project within any of the Planning Districts has the potential to be impacted by the geology or soils that may become unstable during a seismic event. Impacts would be minimized by implementation of standard construction methods and, where applicable, implementation of MM GEO-1. Construction projects have the potential for soil loss due to wind erosion throughout all planning districts at Edwards AFB. Once construction is complete, potential loss of soil due to wind or storm water erosion would not likely exceed current developed conditions found throughout much of Edwards AFB. Impacts would be less than significant with implementation of MM GEO-2 through MM GEO-5.

Hazardous Materials and Hazardous Waste. Construction and operation of projects associated with Alternative 1 would not mobilize existing contaminants associated with identified Operable Units (OU) at Edwards AFB in groundwater or soil, or expose workers to contaminated soils or groundwater. No adverse impacts related to Environmental Restoration Program (ERP) would be expected and no mitigation is required. The use of hazardous materials during development under Alternative 1 is anticipated to be limited to construction vehicle maintenance activities and construction materials. These materials would be required to be properly contained, manifested, and managed in accordance with all Federal, State, and Local

regulations, AFIs, and DoD Directives. No long-term change in existing hazardous materials and hazardous waste management would occur as a result of any development. All Federal, State, and Local environmental laws would continue to be observed, as well as preventative measures contained in the Edwards AFB Hazardous Waste Management Plan (HWMP). Implementation of MM HAZ-1 would further reduce adverse impacts related to hazardous materials and waste to a level that is not significant.

Infrastructure. In general, the infrastructure systems at Edwards AFB (electricity, natural gas, wastewater, stormwater, roadway network) are functioning at acceptable levels. Implementation of MM INF-1 and MM INF-2 would help to reduce impacts to a level that is not significant.

Land Use. No significant effects on land use would occur from implementation of the IDP as future land use is not expected to change. No mitigation is required.

Natural Resources. Potential direct and indirect impacts to general vegetation and wildlife communities, as well as sensitive species and habitats could occur primarily in areas where ground disturbing activities may occur. Implementation of MM BIO-1 through MM BIO-4 would reduce impacts to a less than significant level.

Noise. Construction noise would be primarily from construction vehicles and equipment. Impacts would be short term and temporary. Implementation of MM NOI-1 would reduce impacts to a less than significant impact. Operational noise could come from additional trips but would not be significant.

Socioeconomics. The regional economy would benefit from increased expenditures incurred at Edwards AFB from construction activities for new or renovated facilities. Under this alternative, impacts would be spread out over 5 to 10 years and no significant increases in personnel are expected. Construction workers are anticipated to come from the local area with companies primarily utilizing their existing employees. No adverse impacts are anticipated and no mitigation is proposed.

Water Resources. Construction of potential projects that involve ground disturbing activities has the potential to impact surface water quality or result in erosion. New development is not proposed in flood hazard areas. Implementation of MM HYD-1, MM HYD-2 and MM HYD-3 would reduce impacts to a less than significant level.

Cumulative Impacts. With implementation of Alternative 1 (High Intensity Development Alternative), impacts for most resources would be localized and negligible and, therefore, would have no impacts that would contribute to cumulative impacts in the area. However, there is the potential for minor cumulative impacts for air quality and greenhouse gases, cultural and paleontological resources, and natural resources. Implementation of relevant minimization measures would ensure that impacts would remain at a level that is not significant. Implementation of Alternative 2 (Basic Maintenance Alternative) or Alternative 3 (No Action Alternative) would not result in any appreciable change or increase in impacts for any resource because so little development would occur and would be limited to areas on Edwards AFB that have already been developed.

SUMMARY OF MINIMIZATION MEASURES: The following MMs would be incorporated into the project, thereby ensuring that all impacts would remain at a level that is not significant.

MM AIR-1: Project activities shall comply with all applicable rules and regulations as identified in AFI 32-7040, *Air Quality Compliance and Resource Management* (2014).

MM AIR-2: The project shall comply with all applicable Easter Kern Air Pollution Control District (EKAPCD), Mojave Desert Air Quality Management District (MDAQMD) or Antelope Valley Air Quality Management District (AVAQMD) rules and regulations and obtain the necessary air quality permits. Emissions from permitted devices and activities must be tracked and reported to the California Air Resources Board (CARB), the appropriate air district and the United States Environmental Protection Agency (USEPA). Air quality permits, if required, shall be coordinated through the Environmental Management Division at Edwards AFB. The Environmental Management Division is the lead agency for the application and maintenance of air quality permits on Edwards AFB. Very few, if any, air quality permits would be required for this project as the majority of emissions will be due to mobile sources.

MM AIR-3: Any internal combustion engine subject to National Emissions Standards for Hazardous Air Pollutants (NESHAP) or New Source Performance Standards requirements must be permitted by the local Air Quality Management District (AQMD)/Air Pollution Control District (APCD). Based on recent revisions to the Reciprocating Internal Combustion Engine NESHAP, all stationary generators are now subject to the regulation regardless of size; this in turn makes them subject to permitting requirements. Permitting is also required (retroactively) for any non-road engine that fails the indicia of portability (i.e., exceeds the 12-month time limit). If such equipment is to remain on base less than 45 calendar days, a written exemption must be obtained from the local air agency.

MM AIR-4: The proposed project shall not discharge from any source whatsoever, such quantities of air contaminants or other material that would: cause injury, detriment, nuisance or annoyance to any considerable number of persons or to the public; endanger the comfort, repose, health or safety of any such persons or the public; or cause or have a natural tendency to cause injury or damage to business or property.

MM AIR-5: All earthwork activities shall be planned and conducted to minimize the duration that soils would be left unprotected. The extent of the area of disturbance necessary to accomplish the project shall be minimized. Exposed surfaces shall be periodically sprayed with water.

MM AIR-6: Visible emissions (e.g., dust or smoke) from the proposed projects shall not exceed the limitations as outlined by the local air district.

MM AIR-7: Apply water or dust suppressants to roads and open areas where dust is being generated. If winds produce excessive visible emissions, erect wind barriers. Do not grade or till compacted dirt without applying water or dust suppressant.

MM AIR-8: Discontinue grading and other ground-disturbing activities at wind speeds exceeding 25 miles per hour (mph).

MM AIR-9: All vehicles transporting fill material or debris shall be covered to reduce $PM_{2.5}$ and PM_{10} emissions during transport.

MM AIR-10: Temporary coverings must be installed over open storage piles.

MM AIR-11: All mechanical and construction equipment shall be kept in good working order according to applicable technical orders and the manufacturer's equipment maintenance manuals to reduce emissions to acceptable levels.

MM AIR-12: The following dust control measures will be implemented during land preparation (i.e., clearing, grading, etc.), excavation and/or post-construction:

- All soil excavated or graded should be sufficiently watered to prevent excessive dust. Watering should occur as needed with complete coverage of disturbed soil areas. Watering should be a minimum of twice daily on unpaved/untreated roads and on disturbed soil areas with active operations.
- All clearing, grading, earth moving and excavation activities should cease during periods of winds greater than 20 mph (averaged over one hour), if disturbed material is easily windblown or when dust plumes of 20% or greater opacity impact public roads, occupied structures or neighboring property.
- All fine material transported off site should be either sufficiently watered or securely covered to prevent excessive dust.
- All haul trucks should be required to exit the site via an access point where a gravel pad or grizzly has been installed.
- Stockpiles of soil or other fine loose material shall be stabilized by watering or other appropriate method to prevent wind-blown fugitive dust.
- Once clearing or grading has ceased, all inactive soil areas within the project area should either be seeded and watered until plant growth is evident, treated with a dust palliative or watered twice daily until soil has sufficiently crusted to prevent fugitive dust emission.
- On-site vehicle speed should be limited to 15 mph.
- All areas with vehicle traffic should be paved, treated with dust palliatives or watered a minimum of twice daily.
- Streets adjacent to the project site should be kept clean and accumulated silt removed.
- Revegetation/restoration shall be required based on the level of disturbance created from project activities. Revegetation/restoration shall be in accordance with the *Edwards Air Force Base Revegetation Plan* (AFFTC/EM 1994).

MM AIR-13: The following measures should be implemented to control construction vehicle tailpipe emissions:

- Properly maintain and tune all internal combustion engine powered equipment;
- Require employees and subcontractors to comply with the CARB idling restrictions for compression ignition engines; and
- Use CARB diesel fuel.

MM CUL-1: Avoidance is the preferred treatment for National Register of Historic Places (NRHP)-eligible cultural resources. If avoidance is not possible, then resources will need to be evaluated prior to any development and construction within a proposed Planning District, and any potentially NRHP-eligible resources will require resolution of the adverse effects. Construction monitoring may be implemented in areas where subsurface cultural resources are

anticipated. Additional site-specific mitigation may be implemented prior to development in any of the Planning Districts. In addition, any projects developed for a proposed Planning District should be coordinated with the Base Archaeologist and/or Base Architectural Historian. This coordination will address resource-specific mitigation, which may be further developed through consultation with the California State Historic Preservation Officer (SHPO) or through Native American consultation.

MM GEO-1: Prior to final project design, a geotechnical study should be conducted by a qualified geologist/engineer to identify site-specific geologic conditions and potential geologic hazards in sufficient detail to support sound engineering. Appropriate mitigations for identified geological hazards would be identified in the geotechnical study.

MM GEO-2: Prepare and implement a construction Storm Water Pollution Prevention Plan (SWPPP) prior to the commencement of soil disturbance activities associated with construction.

MM GEO-3: Use non-hazardous dust suppression palliatives approved by Edwards AFB and water on an as-needed basis to suppress wind-blown dust generated at the site during construction. Dust suppression palliatives are materials that work by either agglomerating the fine particles, adhering/binding the surface particles together, or increasing the density of the surface material.

MM GEO-4: Implement erosion control measures during construction, including stabilization of construction areas, employing a concrete wash out area, as needed, and tire washes near the entrance to existing roadways.

MM GEO-5: Install silt fences for erosion control during construction.

MM HAZ-1: Project activities shall comply with all applicable rules and regulations as identified in AFI 32-7086, *Materials Management* (2015) and AFI 32-7042, *Waste Management* (2014).

MM INF-1: Evaluate construction projects that could potentially affect stormwater flows and provide appropriate drainage improvements before project initiation.

MM INF-2: Complete an updated transportation network study of the entire installation to assess current conditions, analyze Level of Service (LOS), condition of roads, and key intersections.

MM BIO-1: Projects would be sited preferentially as follows:

- Within areas covered by engineered surfaces such as asphalt or gravel.
- Within already disturbed areas where native vegetation has been removed (bare soil or non-native vegetation)
- Within areas of native habitat, and only when the project cannot be sited elsewhere.

The Basewide Biological Opinion (8-8-814-F-14; USFWS 2014 – found in Appendix F with terms and conditions listed on pages 7 through 11) shall be adhered to and the installation MMs will be followed to the extent possible and used during pre-project planning to assess and avoid potential impacts to biological resources.

MM BIO-2: All projects would be submitted during the planning phases (i.e., 30% design) to the Edwards AFB Environmental Management office for review by a biologist familiar with the

natural resources on Edwards AFB. If the biologist determines that the location and nature of the project does not require pre-construction surveys and/or monitoring, the project will proceed without such activities. If a pre-construction survey is deemed prudent, it will be conducted by a desert tortoise Authorized Biologist approved by the U.S. Fish and Wildlife Service (USFWS). If a preconstruction survey determines that monitoring is required, it will be conducted by a desert tortoise Authorized Biologist approved by the USFWS. Other reasonable and prudent avoidance or minimization measures may be deemed necessary by Environmental Management office review.

If deemed necessary by the biological review, biological monitors will be employed for the project to ensure that project activities:

- Use only personnel who have completed natural resources training, which can be conducted in the field as necessary.
- Comply with all terms and conditions of the basewide Biological Opinion (8-8-14-F-14; USFWS 2014 – found in Appendix F with terms and conditions listed on pages 7 through 11), or other permitting related to that activity.
- Do not result in the violation of any State and Federal Endangered Species Acts through the unauthorized take of a listed species.
- Document all such training and compliance activity for inclusion in permitting reports as required.

MM BIO-3: If possible, schedule all work outside of the nesting season (generally February through August but largely depending on seasonal weather patterns). If work is to occur during nesting season, conduct a nesting survey of the work area both within one week of the start of construction to identify potential nesting issues that can be avoided, and again immediately prior (within 24 hours) to the initiation of construction or demolition activities. If a nest is found during work activities, work will stop in the immediate area of the nest and a biologist will be called to inspect the nest and determine the best course of action, including the potential of establishing temporary avoidance areas until nesting is completed. Projects will be checked for nesting activities throughout construction or demolition activities at intervals determined by the project biologist and based on the type and location of the activities. Nest monitoring will be focused within the most common breeding season of February through August but may also be necessary in other seasons and will be conducted as determined for a specific project based on the project biologist's recommendations related to the nature and specific location of the activities.

MM BIO-4: During any project activities that occur within or adjacent to native habitats, or when project review by the biologist deems it necessary the following measures will be implemented:

- If vehicles and equipment used will arrive from off-base, these vehicles and equipment will be cleaned prior to use at the site to avoid importing seeds of non-native species onto Edwards AFB;
- Erosion control measures and borrow materials used will be certified weed free to the extent possible;

- Landscaping of project areas will use only species native to the western Mojave Desert to avoid the spread of non-native species on Edwards AFB.
- Herbicides must be applied in accordance with the Edwards AFB Integrated Pest Management Plan (2016).

MM NOI-1: Noise levels could be reduced by limiting construction noise to daytime (e.g., 7:00 a.m. to 7:00 p.m.) and shortening work periods. In addition, noise levels would be minimized by keeping the construction activities at a distance from residential areas, where possible and where necessary. Where noise may be a concern during construction, monitoring at the receptor location may be considered to minimize impact to sensitive receptors and communities. Noise levels would return to background levels once construction activities cease.

MM HYD-1: Selected projects in any of the planning districts may require a SWPPP in support of a National Pollutant Discharge Elimination System (NPDES) permit in connection with construction activities. Implementation of a SWPPP would protect downstream water quality, as sediment erosion would be controlled and sediment movement from the proposed alternative during construction would be reduced.

MM HYD-2: To reduce hazards from flooding, construction should be limited to areas outside 100-year flood zones.

MM HYD-3: No construction or earthmoving should occur that would result in the modification of existing natural drainages; nor should it occur on a dry lake that is not dry.

SUMMARY OF PUBLIC REVIEW AND INTERAGENCY COORDINATION: Copies of the Draft EA were mailed to 1 agency, 4 libraries, the five Federally recognized tribes that Edwards AFB consults with and the California State Clearinghouse. A public notice was published in the Antelope Valley Press and the Mojave Desert News on 14-16, 22 and 23 and 26-28 April 2017. 14 April 2017 began the public comment period. The public comment period ended on 28 April 2017.

FINDING OF NO SIGNIFICANT IMPACT (FONSI):

Based upon my review of the attached EA, I conclude that none of the Alternatives would have a significant, direct, indirect or cumulative impact on the environment. A FONSI for the Proposed Action and Alternatives is made based on the absence of potentially significant impacts to the natural and manmade environment of Edwards AFB. Accordingly, the requirements of NEPA, regulations promulgated by the President's Council on Environmental Quality, and 32 CFR part 989 are fulfilled and an Environmental Impact Statement is not required. Background information that support the research and development of this FONSI and EA is on file at Edwards AFB and can be obtained by contacting the following:

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412th Test Wing Public Affairs
Attn: Mr. Gary Hatch
305 East Popson Avenue, Building 1405
Edwards AFB, CA 93524-8060
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James E. Judkins

JAMES E. JUDKINS, NH-IV
Base Civil Engineer

7 June 17
Date

412th Civil Engineer Group
Environmental Management Division
Edwards Air Force Base, California

FINAL
ENVIRONMENTAL ASSESSMENT

IMPLEMENTATION OF THE INSTALLATION DEVELOPMENT PLAN

EDWARDS AIR FORCE BASE, CALIFORNIA

May 2017

Project File: Environmental Assessment for Implementation of the Installation Development Plan at Edwards Air Force Base, California
AF Form 813 #13-0188

COVER SHEET

ENVIRONMENTAL ASSESSMENT FOR IMPLEMENTATION OF THE INSTALLATION DEVELOPMENT PLAN AT EDWARDS AIR FORCE BASE, CALIFORNIA

Lead Agency: U.S. Air Force

Cooperating Agency: None

Proposed Action: Implementation of Installation Development Plan

Point of Contact: Inquiries on this document should be directed to the 412th Test Wing Public Affairs, Attn: Gary Hatch, 305 East Popson Avenue, Building 1405, Edwards Air Force Base, California 93524, (661) 277-8707, e-mail 412tw.pae@us.af.mil

Report Designation: Draft Environmental Assessment (EA)

Abstract: This EA evaluates the potential environmental impacts associated with implementation of the Installation Development Plan (IDP) at Edwards AFB, California. The IDP is a planning tool for leadership and decision makers of the 412th Test Wing, Air Force Materiel Command and United States (US) Air Force (AF) in making good development decisions in support of future commitments that will support the mission at Edwards AFB. In order to test, evaluate and develop weapon systems to deliver superior capability to the Nation's combat forces, the installation requires a guide for future installation development decisions. The IDP outlines future requirements that will enhance mission capability for the entire 412th Test Wing. The IDP was prepared in accordance with Air Force Instruction (AFI) 32-7062, *Comprehensive Planning*, together with principles from Unified Facilities Criteria (UFC) 2-100-01, *Installation Master Planning*.

The underlying need for the IDP is to support the Edwards AFB test mission. The IDP serves as the planning tool for demolition, construction and modification of facilities and infrastructure that have been identified by Edwards AFB as critical in supporting current and projected mission needs. To that end, the overall purpose of the IDP is to identify and address major development projects as well as major repair and maintenance projects that would support the mission statement by optimizing operational efficiencies and resolving incompatible land use issues at Edwards AFB. The EA analyzes the potential impacts of implementing the IDP over the next 10 years or so. This was analyzed as a High Intensity Development Alternative. Two additional alternatives, including the No Action Alternative were analyzed as well.

This EA was prepared in accordance with all applicable Federal, State and Local laws and regulations including the National Environmental Policy Act (NEPA) of 1969, as amended (42 United States Code [USC] 4321 *et seq*.); the Council on Environmental Quality (CEQ) *Regulations for Implementing the Procedural Provisions of NEPA* (40 Code of Federal Regulations [CFR] 1500–1508); and AFI 32-7061, *The Environmental Impact Analysis Process (EIAP)*, as codified in 32 CFR Part 989. The 412th Civil Engineer Group (CEG) is representing the Department of Defense (DoD) as the lead agency.

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APPENDICES

1.0 PURPOSE AND NEED FOR ACTION

1.1 INTRODUCTION

This Environmental Assessment (EA) evaluates the potential environmental impacts associated with implementation of the Installation Development Plan (IDP) at Edwards AFB, California. The IDP is a planning tool for leadership and decision makers of the 412th Test Wing, Air Force Materiel Command and United States (US) Air Force (AF) in making good development decisions in support of future commitments that will support the mission at Edwards AFB. In order to test, evaluate and develop weapon systems to deliver superior capability to the Nation's combat forces, the installation requires a guide for future installation development decisions. The IDP outlines future requirements that will enhance mission capability for the entire 412th Test Wing. The IDP was prepared in accordance with Air Force Instruction (AFI) 32-7062, *Comprehensive Planning*, together with principles from Unified Facilities Criteria (UFC) 2-100-01, *Installation Master Planning*.

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1.2 LOCATION OF EDWARDS AFB

Implementation of the IDP, which is the subject of this EA, would occur on Edwards AFB which is located in the Antelope Valley region of the western Mojave Desert in Southern California, about 60 miles north of Los Angeles, California. Edwards AFB occupies an area of 307,517 acres or 480 square miles and consists of largely undeveloped or semi-improved land that is used predominantly for aircraft test ranges and maintained and unmaintained landing sites (i.e., dry lake beds). Edwards AFB is bounded by State Highways 14 to the west, 58 to the north, US Route 395 to the east and county road Avenue E near the southern boundary of the Installation. Existing development is concentrated into non-contiguous areas, including the central

cantonment area (Main Base), North Base, South Base, Family Housing Area and Air Force Research Laboratory (AFRL) complex. The Precision Impact Range Area (PIRA) spans a large area of the eastern part of the installation and is primarily used for air to ground bombing precision testing and for evaluating targeting capabilities. Rogers and Rosamond Dry lakes occupy approximately 14 percent of the installation area.

Most of Edwards AFB lies within Kern County, with smaller portions in Los Angeles and San Bernardino counties (Figure 1-1). Elevations on Edwards AFB range from approximately 692 to 1,038 meters (2,270 to 3,404 feet) above mean sea level (AMSL) with the lowest elevations found in the two major dry lakebeds, Rogers and Rosamond Dry Lakes. Higher elevation areas are found along ridges in the Rosamond and Bissell Hills in the northwest area of the installation, along Leuhman Ridge in the northeast and Haystack Butte in the southeast.

Edwards AFB has a local climate characterized by distinct summers and winters, with short transition periods in between. Summers are hot and dry, and winters mild and windy. The relatively high altitude (2,300 feet above sea level) and dry atmosphere allow for a large variance in daily temperatures. Most precipitation occurs between November and March, but annual rainfall typically totals 5 inches.

On average, there are 279 sunny days per year in the region. July, the warmest month, has an average high temperature of 99 degrees Fahrenheit while December, the coldest month, has an average low of 30 degrees Fahrenheit.

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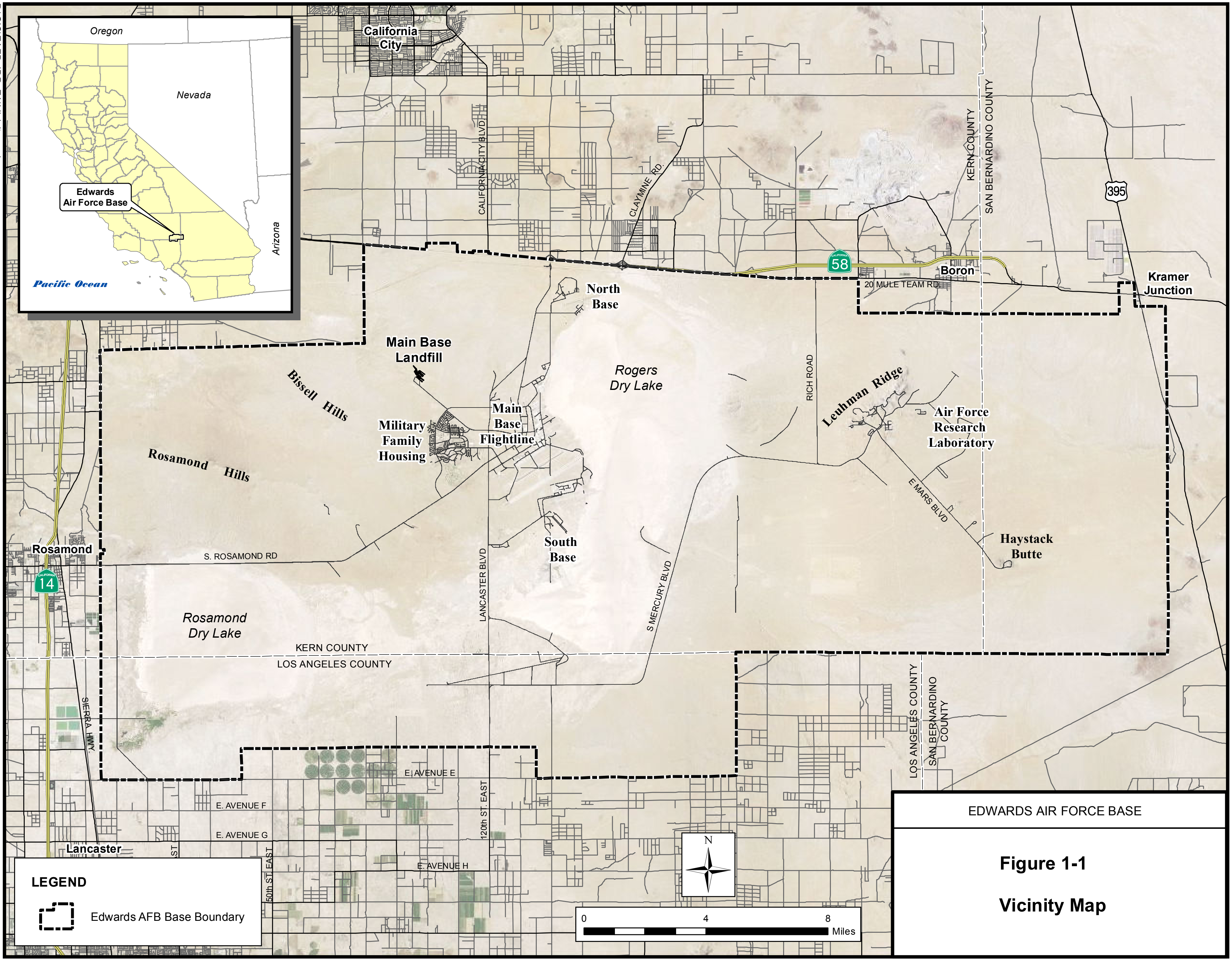


EDWARDS AIR FORCE BASE

Figure 1-1

Vicinity Map

1.3 BACKGROUND AND PLANNING PROCESS

The information in this section is summarized from the *Installation Development Plan, 412th Test Wing, Edwards Air Force Base, California* (Edwards AFB, 2015a).

1.3.1 Installation Development Plan Overview

The 412th Test Wing IDP is the result of a comprehensive planning process that describes the installation's past, present and future physical state and guides future facility programming decisions. The IDP provides a plan for the next 15 to 20 years, but it is a living, flexible document that will be periodically updated to reflect the ongoing strategic vision of the 412th Test Wing.

The IDP was created in accordance with Air Force Instruction (AFI) 32-7062, *Comprehensive Planning*, together with principles from Unified Facilities Criteria (UFC) 2-100-01, *Installation Master Planning*. It is intended to align with overarching AF installation planning goals for mission capability, sustainability, readiness and modernization.

The IDP supports the mission and priorities of 412th Test Wing leadership and higher commands. During the IDP process, a series of goals and objectives were developed to reflect these priorities. Opportunities for future development were identified through a number of analyses, including an evaluation of planning constraints, determination of installation capacities and evaluation of critical metrics called Sustainability Development Indicators (SDIs). Using the results of this evaluation, developable land parcels and future projects were identified as part of planning a district-based development framework. The future projects align with the installation's physical development goals and are organized into a three-phase implementation strategy that includes short-, medium- and long-range timeframes.

The IDP is a snapshot of Edwards AFB as it might look in the future. The IDP process was created with the knowledge that missions change, technologies advance and the surrounding communities will continue to grow and influence the installation's development. As a living document, the IDP has the flexibility to accommodate change and support the installation as it continues to evolve.

1.3.2 Future Development Planning

To remain the DoD's tester of choice, the long-term development vision for the 412th Test Wing must achieve an efficient, sustainable configuration of land use, functions, facilities and transportation networks to support future testing demands. The IDP documents the 412th Test Wing's vision for future development and presents a compilation and summary of resource plans, special plans, studies, support graphics and maps. These materials provide information to assist commanders in making knowledgeable decisions about long-term capabilities.

The future development planning concepts described in the IDP translate the IDP vision, goals and objectives into a concrete physical development scenario. This scenario includes planning districts that define specific geographic areas of the installation to guide in-depth planning. Planning districts help bridge the gap between the installation's overall land use plan and smaller-scale Area Development Plans (ADPs), which can include a significant amount of detail. Individual planning districts are defined by similar types of functions, facilities and infrastructure located in a specific area. The planning district concept includes the definition of permitted land uses within each district. Locating future activities and the projects that support them using planning districts ensures compatibility with existing uses and promotes a disciplined, strategic approach to long-term development. The planning districts are described in detail in Chapter 2 of this EA and include eight major planning districts based on established land-use patterns, current functions, existing facilities and infrastructure and the relationship to the existing transportation network.

1.3.3 Unique Planning Factors

Edwards AFB is a unique installation because of its testing mission. The 412 Test Wing's mission influences everything on the installation and is the source of multiple planning factors that are particular to Edwards AFB:

- Development is project-driven and largely "invisible" to the military construction (MILCON) process. Instead, the installation is heavily dependent on customer funding, which funds only mission-essential facilities. As a result, infrastructure and other non-mission-essential projects are often underfunded.
- Many missions assigned to the 412 Test Wing are classified and cannot be integrated into a base-wide, holistic planning process. As the DoD tester of choice for all aircraft, facilities must maintain a high level of flexibility to accommodate many missions and airframe types. In the foreseeable future, this range of airframes includes the F-35 Joint

Strike Fighter, the KC-46 Pegasus Refueler, an increase in Unmanned Aerial System/Vehicle programs and hypersonic weapons systems.

- The diversity of airframe types require a wider variety of ground support equipment, supplies and other functions.
- The remote location of the installation is ideal for test missions, but is challenging in terms of personnel morale and quality of life.

1.4 PURPOSE OF AND NEED FOR ACTION

The underlying need for the IDP is to support the Edwards AFB test mission. Per AFI 32-7062, *Comprehensive Planning*, bases are required to have an IDP to support the mission. The IDP serves as the planning tool for demolition, construction and modification of facilities and infrastructure that have been identified by Edwards AFB as critical in supporting current and projected mission needs. To that end, the overall purpose of the IDP is to identify and address major development projects as well as major repair and maintenance projects that would support the mission statement by optimizing operational efficiencies and resolving incompatible land use issues at Edwards AFB. The IDP vision statement is:

> *Edwards AFB is the Department of Defense's tester of choice for developmental test and evaluation, providing flexible, cost-effective facilities and infrastructure to accommodate unique test procedures and weapons systems.*

1.5 SCOPE OF THE ANALYSIS

This IDP EA provides an analysis of the potential environmental consequences associated with implementation of a reasonable range of projects involved in modernizing and upgrading Edwards AFB to meet current and future requirements. If projects unforeseen as part of the planning in the IDP are proposed at a future time, those projects would need additional planning and subsequent environmental analysis.

1.6 ISSUES AND CONCERNS CONSIDERED

During the scoping process, the following issues and concerns were identified as requiring assessment when considering the potential environmental impacts of the proposed project and alternatives:

- Air Quality and Greenhouse Gases

- Cultural and Paleontological Resources
- Geology and Soils
- Hazardous Materials and Waste
- Infrastructure
- Land Use
- Natural Resources
- Noise
- Socioeconomics
- Water Resources

1.7 ISSUES AND CONCERNS DISCUSSED BUT NOT CONSIDERED RELEVANT FOR FURTHER ANALYSIS

The following issues and concerns were initially considered, but subsequently eliminated from analysis in this EA because they are not applicable to this project or would not result in significant impacts. Consequently, they will not be addressed in Chapters 3 and 4.

- **Airspace.** None of the proposed projects would affect the management or use of the airspace at Edwards AFB or the surrounding area.
- **Public Safety/Emergency Services.** None of the proposed projects would affect overall public safety at Edwards AFB, nor affect emergency services.
- **Environmental Justice and Protection of Children.** The Executive Orders (EOs) on Environmental Justice and the protection of children require Federal agencies to identify and address disproportionately high adverse effects of their activities on minority and low-income populations and children. Given that all proposed projects would occur entirely on Edwards AFB, the AF has determined that this action would have no substantial, disproportionate impacts on minority and low-income populations and/or children.

1.8 PUBLIC INVOLVEMENT PROCESS

Relevant Federal and State resource agencies, Native American tribes and local document repositories are on the project mailing list and were sent copies of the Draft EA to ensure that stakeholders had the opportunity to comment. Draft EA availability was also highlighted via ads in local area newspapers. Chapter 6 contains a list of agencies and organizations to whom the Draft EA was sent.

2.0 DESCRIPTION OF ALTERNATIVES

The criteria established for selecting a reasonable range of alternatives are identified. In addition, this chapter provides a description of the eight planning districts developed as part of the IDP and that encompass the entire installation. This chapter also describes three alternatives that are analyzed in this EA: High Intensity Development Alternative, Basic Maintenance Alternative and the No Action Alternative.

2.1 CRITERIA FOR SELECTION OF A REASONABLE RANGE OF ALTERNATIVES

In order to determine the types of projects to include in the alternatives, it is important to look generally at the goals and objectives for the Edwards AFB IDP and to look more specifically at the compilation of projects identified in the IDP, all of which are consistent with the IDP. In addition, the projects would need to be consistent with environmental criteria which address environmental considerations at Edwards AFB.

2.1.1 Consistency with the Installation Development Plan

The intent of the IDP goals and objectives is to further the implementation of the IDP vision and emphasize the physical development of the installation. Goals and objectives are recommended in the following categories and are updated as needed to reflect current needs at Edwards AFB:

- AF mission capability
- Installation facilities and infrastructure
- Sustainability, conservation and environmental stewardship
- Community relationships
- Quality of life

The latest version of the IDP contains the latest goals and objectives for the IDP and are hereby incorporated by reference (Edwards AFB, 2015a).

Implementation of the future development plan would be achieved incrementally based on funding priorities and new test mission requirements.

The future development plan is divided into the following three phases:

- **Short-range:** These projects are planned for construction within the next 1 to 5 years. They are in the funding and design phases and have received most of the necessary approvals for construction.
- **Medium-range:** These projects are planned for construction in the next 6 to 10 years or respond to an identified need for a facility within the next 6 to 10 years. They address identified needs based on mission requirements, facility conditions, or new missions.
- **Long-range:** These projects are planned for construction 11 or more years in the future. They have been identified as long-term needs and are not considered in this EA.

Not shown in the IDP are numerous smaller scale sustainment, restoration and modernization (SRM) infrastructure and facility improvement, repair and renovation projects needed to enable continued mission execution and success. Chapter 10 of the IDP, *Plan Implementation*, outlines major facility construction projects based on current status and urgency.

2.1.2 Environmental Criteria

The following environmental criteria were also used in the selection of projects to be included in the alternatives:

- Minimize impacts to biological and cultural resources
- Prohibit development in floodplains
- Limit new ground disturbance
- Avoid existing restoration sites
- Minimize long-term risk to the environment
- Identify opportunities to improve the environment

2.1.3 Conclusion

The alternatives selected for analysis in this EA met the goals and objectives for the IDP and are consistent with the environmental criteria identified above. In particular, the administration at the installation has made a decision to prohibit developments or actions that encroach on the currently delineated floodplains.

In addition, with the high intensity development alternative, it is assumed that projects would be developed over 5 to 10 years (short- to medium-range projects). It should be noted that, given the project-driven nature of many projects that come to Edwards AFB that are difficult to predict

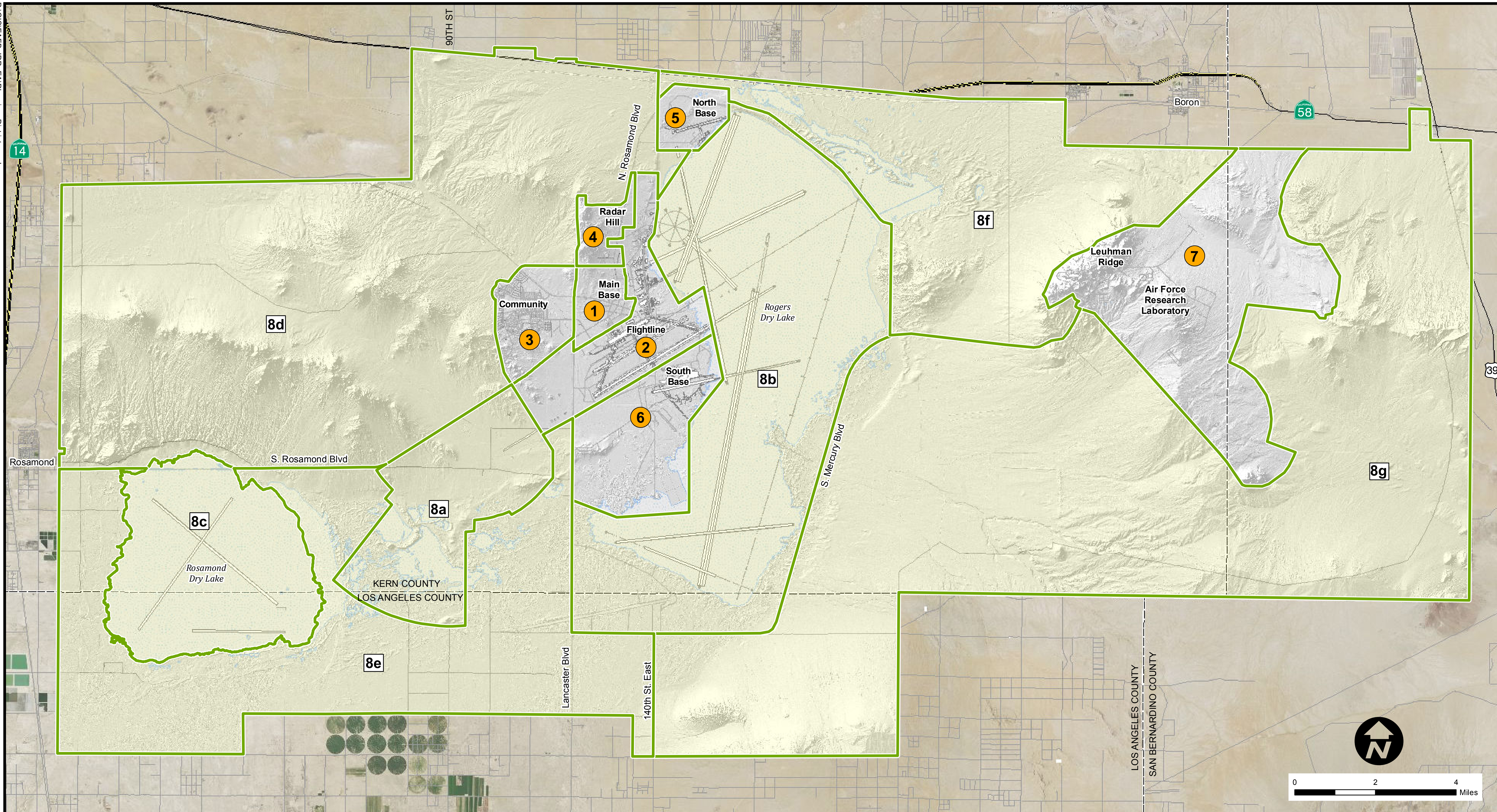
or plan for, it is likely that unforeseen projects will occur at Edwards AFB and will need additional planning or environmental analysis at that time.

2.2 PLANNING DISTRICTS OVERVIEW

Eight planning districts that encompass the entire installation were created as part of the IDP to organize future development into geographic areas (Figure 2-1). Planning districts are geographic places that are a means to organize and describe future development. Planning districts help bridge the gap between the 412th Test Wing's overall land use plan and smaller-scale ADPs. Each district can be thought of as a distinct "place" and was defined based on similar activities, framework plan elements, relationships to the existing transportation network and established land-use patterns.

In total, seven of the planning districts represent the developed areas or those that are within the edges of the framework map. The eighth district, titled Special Use, is the land outside these developed areas. The Special Use District was created to address the unique, mission-critical functions of the aircraft testing and evaluation ranges and military training ranges found there. Other functions found in these districts include outdoor recreation and historic preservation.

Each planning district is described in detail in the following sections and includes the following information: overview, relationship to overall future development, constraints and issues.



Planning District Boundary

Special Use Planning District

EAFB Installation Boundary

PLANNING DISTRICTS

1 Main Base Planning District
2 Flightline Planning District
3 Community Planning District
4 Radar Hill Planning District
5 North Base Planning District
6 South Base Planning District
7 AFRL Planning District

SPECIAL USE PLANNING DISTRICT

8a Military Training Planning Sub-district
8b Rogers Dry Lakebed Planning Sub-district
8c Rosamond Dry Lakebed Planning Sub-district
8d Testing & Evaluation North Planning Sub-district
8e Testing & Evaluation South Planning Sub-district
8f Rich Road Planning Sub-district
8g PIRA Planning Sub-district

EDWARDS AIR FORCE BASE

Figure 2-1

Planning Districts

2.2.1 Main Base Planning District

The Main Base Planning District is the heart of the installation (Figure 2-2). It is bounded by Wolfe Avenue to the east (with the exception of the Propulsion Area), Forbes Avenue to the north and Lancaster Boulevard to the west. Rosamond Boulevard is the major district thoroughfare and separates the administrative and flightline-related uses in the east from the more community-oriented functions to the west. Land use is a mixture of administrative, light industrial, community (services), housing (unaccompanied), outdoor recreation and open space.

To the east of Rosamond Boulevard is the 412th Test Wing Headquarters, Air Force Test Center (AFTC) Headquarters, Aeromedical Clinic, public affairs, contract management, accounting and finance, ground safety and a number of test and evaluation facilities. To the west of Rosamond Boulevard are Airmen dormitories, major recreation facilities, Joshua Tree Dining Hall, Library, Chapel 1, transportation administration, Civil Engineering, Security Forces Squadron (SFS) and small storage facilities.

Relationship to Overall Future Development

The greatest number of future projects would occur in the Main Base Planning District. These projects include the consolidation of dispersed facilities, creation of a denser administrative core, improvements to recreation and fitness facilities and expanded warehouse and storage space. Additionally, two blocks along Gregorius Avenue at the intersection of Supply Road are proposed to become a small warehouse area.

Constraints

Main Base has few operational, natural or built constraints. Its land area is relatively flat and in most places there is easy access to existing infrastructure that can support future development. Small contaminated groundwater plumes north of Yeager Boulevard are a minor constraint.

Issues

- Additional storage is needed
- Additional administrative space is needed
- Communications facilities are dispersed and inadequate
- SFS facilities are dispersed and inadequate

- The Rosburg Fitness Center is undersized and beyond its useful lifespan
- Dormitories are isolated from the services in the Community Planning District
- Dormitories are in degraded condition and do not meet the 2003 Dorms-4Airmen configuration standards

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Main Base Planning District Planned Demolition	
Facility No.	Square Footage
3498 - Base Engineer Covered Storage	1,307
3499 - Base Engineer Covered Storage	6,611
3516 - Vehicle Dispatch Office	437
Total square footage to be removed	8,355
% of total square footage at EAFB	(-0.1%)

Short-range Projects

- 4 Warrior Fitness Center
- 6 ECIP Solar Parking

Medium-range Projects

- 12 Readiness Warehouse
- 14 MXG Warehouse
- 19 Distributed Telecommunications Facility
- 22 Vehicle Wash Rack B3700

Long-range Projects

- 25 Communications Squadron Warehouse
- 30 New Dormitory
- 31 Fitness Maintenance Facility
- 32 Consolidated Engineering Facility
- 36 Flight Test Engineering Support Facility
- 38 Consolidated SFS Compound

Planned Demolition

- 1 3498 - Base Engineer Covered Storage
- 2 3499 - Base Engineer Covered Storage
- 3 3516 - Vehicle Dispatch Office

Developable Parcels

- Tier 1 - Most Developable
- Tier 2 - Demolition Required
- Tier 3 - Weak Infrastructure Links

Planning District Boundary

EDWARDS AIR FORCE BASE

Figure 2-2

Main Base Planning District

2.2.2 Flightline Planning District

The Flightline Planning District includes a large concentration of aircraft operations, aircraft maintenance and research and testing facilities (Figure 2-3). Bounded on the west by Wolfe Avenue, the district boundaries shift one block west to incorporate the Propulsion Area and include the National Aeronautics and Space Administration (NASA) Armstrong Flight Research Center (AFRC) facilities on the far north of the flightline. Rogers Dry Lakebed forms the eastern boundary and directly south is the South Base Planning District. Land use is primarily aircraft operations and maintenance with some small pockets of industrial uses and open space corresponding to airfield safety clearances.

The Flightline Planning District is divided into three zones: 1) the area adjacent to the Main Ramp and closest to the paved runways, 2) research and testing facilities that are oriented toward Rogers Dry Lakebed and 3) the NASA AFRC campus. Major facilities in the district include Runways 04R/22L and 04L/22R, the main ramp, Base Operations, the Ridley Mission Control Center, the Benefield Anechoic facility and the US Air Force Test Pilot School (TPS). Other facilities include hangars, research and development laboratories, precision measurement equipment, back shops, aircraft corrosion control and propulsion shops.

The northern section of the district is leased to NASA and will be dedicated to only NASA-funded projects. The NASA AFRC complex functions independently of the installation and is funded by other sources; therefore, lands leased to NASA are not included in the IDP calculations.

Relationship to Overall Development

Property adjacent to the flightline is a valuable resource and of all the planning districts, the Flightline Planning District has the least amount of developable land. The limitation on developable area, combined with the need to accommodate multiple types of airframes, requires that facilities be as flexible as possible.

Constraints

The Flightline Planning District has a number of constraints to development. The runways' primary surfaces, clear zones (CZs), and accident potential zones (APZs) pose stringent

restrictions. Other constraints include multiple explosive safety quantity distance (ESQD) arcs, eight National Register of Historic Places (NRHP) -eligible structures and potential archaeological sites. The majority of the district is also located on substantial contaminated groundwater plumes that must be mitigated.

Issues

- There is a limited amount of developable land
- The need to balance flexibility to accept new missions with the 20/20 by 2020 space optimization directive is difficult to implement
- The obligation to maintain facilities for multiple types of aircraft from legacy missions while accepting new missions and new airframes requires sufficient space to balance simultaneous project needs for similar types of space
- Propulsion flight facilities are old and deteriorated
- Land around Lancaster Boulevard is prone to flooding
- Auxiliary Runway 04L/22R is technically a temporary structure and classified as “equipment,” which cannot be funded through typical operation and maintenance (O&M) sources
- Development near the flightline may increase the potential for bird aircraft strike hazards (BASH) because construction of buildings increases nesting and roosting habitat for birds.

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Flightline Planning District Planned Demolition	
Facility No.	Square Footage
1400 - Technical Directorate 412 TW	67,440
1910 - Change House/Hoist Control	279
Total square footage to be removed	67,719
% of total square footage at EAFB	(-0.77%)

0 2,000 4,000 Feet

Short-range Projects

- 5 Flightline Fire Station
- 6 ECIP Solar Parking

Medium-range Projects

- 13 Replace Storage Building 1036
- 20 Engine Test Cell / Propulson Complex Upgrades

Long-range Projects

- 23 EW Warehouse Building 1036
- 29 Install Homeruns Runway 04L/22R
- 33 1634 Corrosion Control
- 37 Aircraft Munitions Loading Pad
- 39 Avionics Test Engineering Facility

Planned Demolition

- 5 1400-Technical Directorate 412 TW
- 6 1910 - Change House/Hoist Control

Developable Parcels

Tier 1 - Most Developable

Planning District Boundary

Land Leased to NASA

EDWARDS AIR FORCE BASE

Figure 2-3

Flightline Planning District

2.2.3 Community Planning District

One of the newer parts of the installation, the Community Planning District is buffered from the activity of the Main Base and Flightline districts by a 2-mile drive (Figure 2-4**)**. The district is bounded to the east by Lancaster Boulevard, south by Rosamond Boulevard and north along Forbes Avenue (including uses to the west), until Forbes turns east and intersects with Lancaster. Land uses are a mixture of housing (accompanied), community (commercial), community (services), medical, outdoor recreation and open space.

Facilities in this district include all privatized housing managed by Corvias Military Housing; Base Exchange (BX); Commissary; Desert Mall; gas station; Club Muroc; Muroc Lake Golf Course; Bowling Center, youth ball fields and Outdoor Recreation; FamCamp; Air Force Flight Test Museum; Youth Center; child development center (CDC); public schools; Lodging (including temporary lodging facilities [TLF], visiting officer quarters [VOQ] and visiting quarters [VQ]); Medical Clinic; and Chapel 2.

Relationship to Overall Future Development

The Community Planning District is sized appropriately and is not expected to change significantly in the next 10 to 15 years. Anticipated projects include additional amenities at Muroc Lake Golf Course and a solar panel parking cover at the Commissary.

Constraints

The Community Planning District has few development constraints. A geological fault line underscores the area from northwest to southeast and there is a small contaminated groundwater plume in the southeast corner of the district.

Issues

- A large proportion of the district is leased to Corvias Military Housing for 50 years and development of these areas is now beyond the purview of the installation
- Some areas around Yeager Boulevard and Lancaster Boulevard are prone to flooding
- Public schools are owned and operated by Muroc Joint Unified School District

Community Planning District Planned Demolition

Facility No.	Square Footage
5206 - Base Supply Shed	6,232
Total square footage to be removed	6,232
% of total square footage at EAFB	(-0.07%)

EDWARDS AIR FORCE BASE

Figure 2-4

Community Planning District

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2.2.4 Radar Hill Planning District

Radar Hill is characterized by a ridge topped by NASA AFRC radar facilities (Figure 2-5). Historically, the area has been underutilized, but it functions as an important transition zone between the Main Base and testing and evaluation land uses to the north and west. The district is bounded by Forbes Avenue to the south, Lancaster Boulevard/Baker Nunn Road to the west and is adjacent to the Flightline Planning District. The eastern boundary is Rosamond Boulevard. Land uses are primarily industrial and open space, but most of the district is open for off-road vehicle (ORV) recreational use. This was the primary location for Jet Propellant 8 (JP-8) bulk fuel storage; however, this function has changed since the construction of the new Jet-A fuel storage facilities and infrastructure on the flightline in fiscal year (FY) 15. One of the JP-8 storage tanks was retained on the site of the old bulk fuel storage for future use.

Relationship to Overall Future Development

Radar Hill is envisioned to remain a transitional area between the Main Base and Flightline Planning Districts and the Special Use districts. Very limited development is expected, but the district is an ideal location for functions that require safety buffers but still require access to the core of the installation.

Constraints

Radar Hill has greater slopes than other parts of the installation, but most of the slopes do not present a significant constraint to development. However, there is a large contaminated groundwater plume that requires mitigation. Developable parcels north of the rail spur are inadequately served by infrastructure to support new facilities.

Issues

- Part of the district is leased to NASA AFRC and development of this area is beyond the purview of the installation

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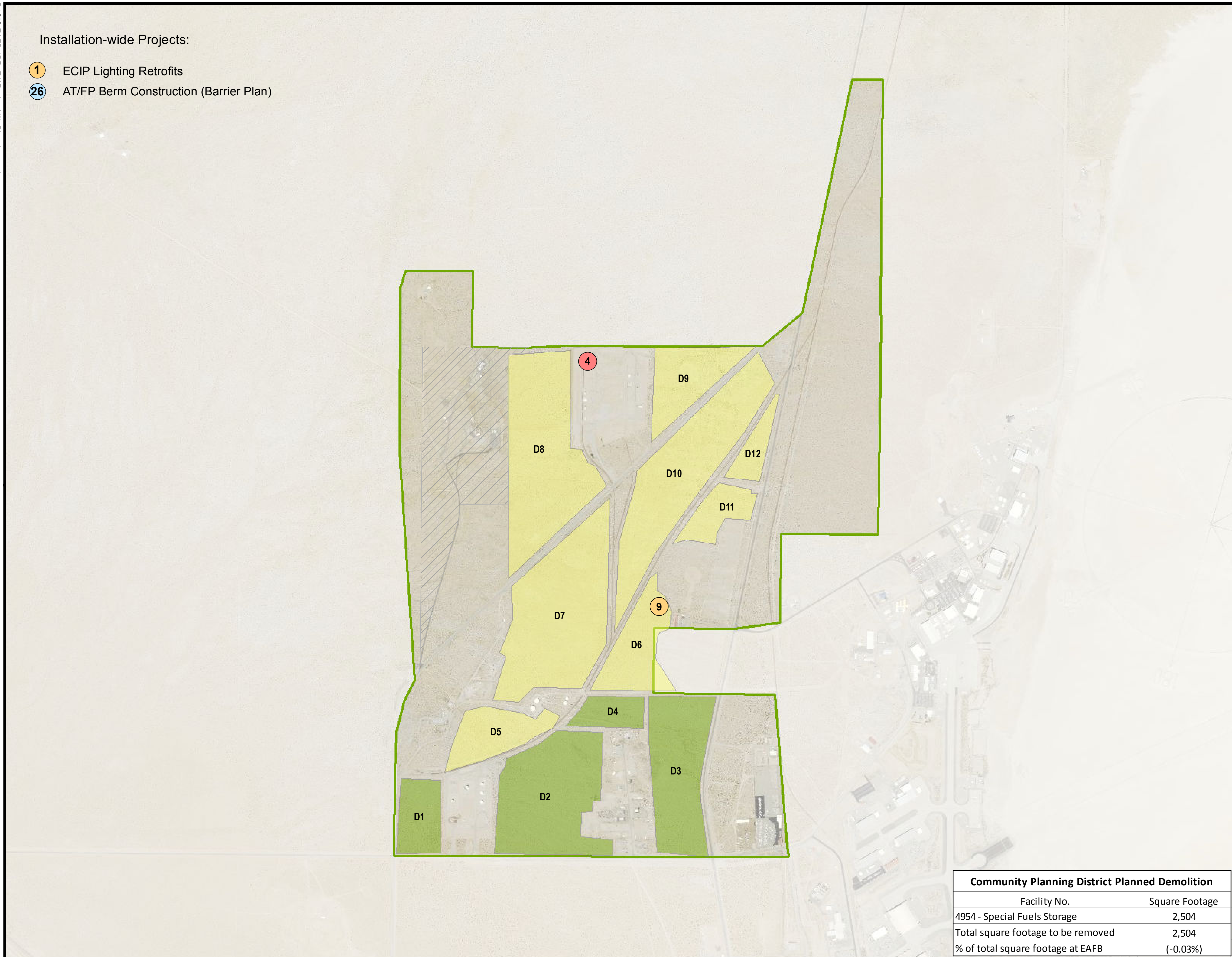

Community Planning District Planned Demolition	
Facility No.	Square Footage
4954 - Special Fuels Storage	2,504
Total square footage to be removed	2,504
% of total square footage at EAFB	(-0.03%)

0 1,500 Feet

Short-range Projects

9 EOD Complex Expansion

Planned Demolition

4 4954 - Special Fuels Storage

Developable Parcels

Tier 1 - Most Developable

Tier 3 - Weak Infrastructure Links

Land Leased to NASA

Planning District Boundary

EDWARDS AIR FORCE BASE

Figure 2-5

Radar Hill Planning District

2.2.5 North Base Planning District

North Base has infrastructure dating back to the 1930s and 1940s. Since the 1950s, it has been used for temporary test programs and most recently was home to the Army Gray Eagle test program. It is close to the North Gate, somewhat remote from the other developed parts of the installation (Figure 2-6). Its northern boundary is near the installation boundary and stretches east to the edge of Rogers Dry Lakebed. Land use is almost exclusively aircraft operations and maintenance. North Base consists of two distinct areas, one north of runway 06/24 and the other to the south. The area north of the runway contains the old Jet Propulsion Lab (JPL) facilities and also serves as the location of the explosive ordnance disposal (EOD) function. South of the runway, the area includes Fire Station 5, the Operating Location facilities and a series of hangars and storage facilities.

Relationship to Overall Future Development

Of all the planning districts, North Base has the greatest capacity for redevelopment and support of new missions. North Base is in a remote location that is close to both lakebed and paved runways, which makes this area suitable for future aircraft testing and evaluation activities. The district provides opportunities for research, development, test and evaluation (RDT&E) programs, such as remotely-piloted aircraft that would be infeasible or incompatible in other areas of the installation. Small, slow moving aircraft can disrupt air traffic flow and present safety hazards when operating on the Main Base runway. Airfield ground traffic is also interrupted by the towing of unmanned aircraft on Main Base taxiways. Migration of most remotely piloted aircraft and light manned aircraft programs to North Base would alleviate these problems and thus remove barriers to growth in these important flight test categories.

Constraints

A significant constraint at North Base is the small, Class-A runway, which is suitable only for smaller or remotely-piloted aircraft. Other constraints include the runway primary surface, CZs, and APZs; ESQD arcs at each end of the runway; and scattered, small groundwater plumes. Aging facilities must be replaced and most of the former JPL facilities are slated for demolition. The district also has four NRHP-eligible structures. Developable parcels south of the runway are better served by existing infrastructure than those north of the runway.

Issues

- The Class-A runway is unsuitable for large aircraft and the condition of airfield ramp is poor
- The district is isolated and difficult to secure
- The Operational Location at North Base must have a secure buffer zone
- Roadways are in poor condition
- Many aging facilities must be upgraded or demolished
- Electrical substation within APZ II

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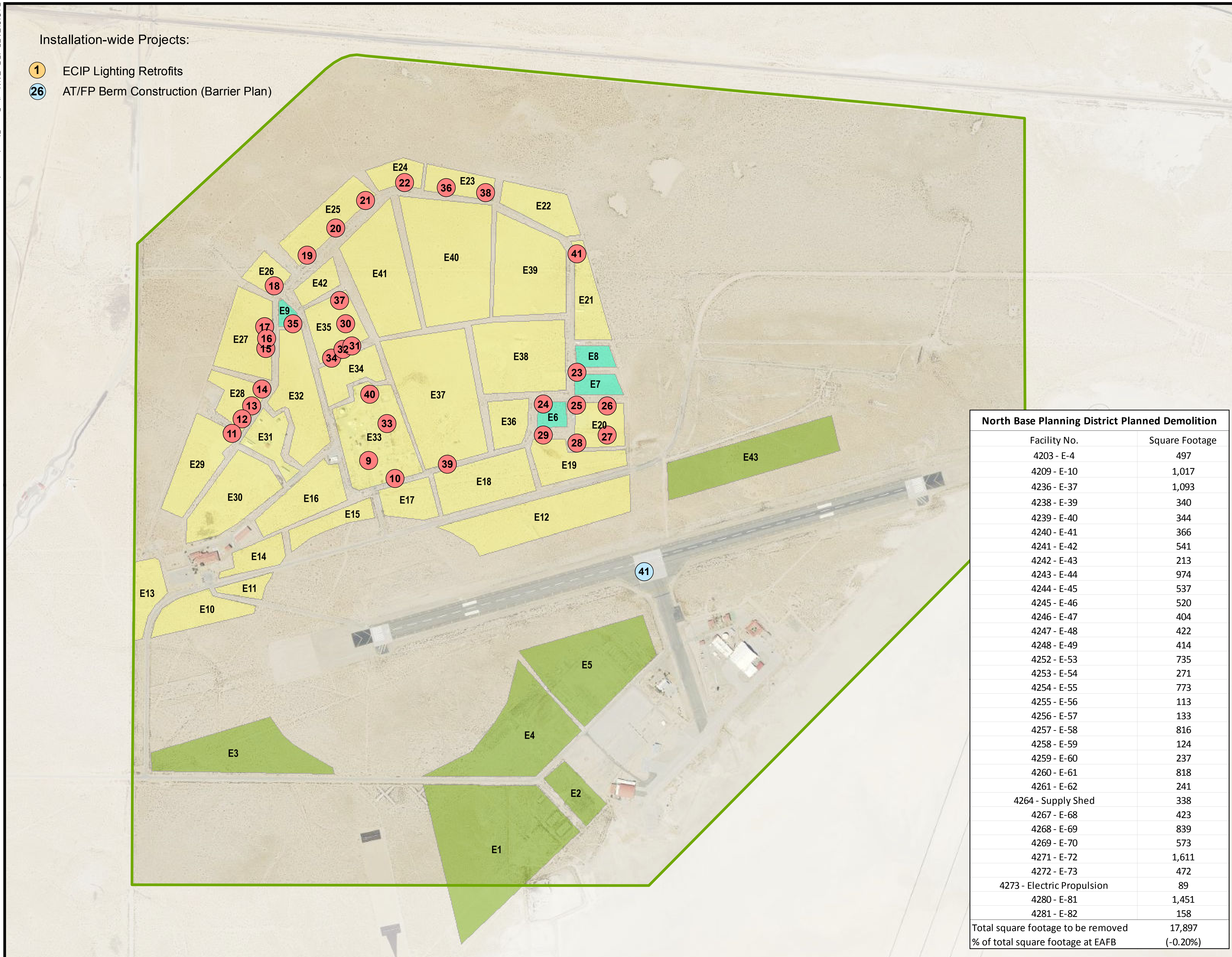


North Base Planning District Planned Demolition

Facility No.	Square Footage
4203 - E-4	497
4209 - E-10	1,017
4236 - E-37	1,093
4238 - E-39	340
4239 - E-40	344
4240 - E-41	366
4241 - E-42	541
4242 - E-43	213
4243 - E-44	974
4244 - E-45	537
4245 - E-46	520
4246 - E-47	404
4247 - E-48	422
4248 - E-49	414
4252 - E-53	735
4253 - E-54	271
4254 - E-55	773
4255 - E-56	113
4256 - E-57	133
4257 - E-58	816
4258 - E-59	124
4259 - E-60	237
4260 - E-61	818
4261 - E-62	241
4264 - Supply Shed	338
4267 - E-68	423
4268 - E-69	839
4269 - E-70	573
4271 - E-72	1,611
4272 - E-73	472
4273 - Electric Propulsion	89
4280 - E-81	1,451
4281 - E-82	158
Total square footage to be removed	17,897
% of total square footage at EAFB	(-0.20%)

Long-range Projects

41 North Base Runway Repairs

Planned Demolition

- 9 4203 - E-4
- 10 4209 - E-10
- 11 4236 - E-37
- 12 4238 - E-39
- 13 4239 - E40
- 14 4240 - E-41
- 15 4241 - E-42
- 16 4242 - E-43
- 17 4243 - E-44
- 18 4244 - E-45
- 19 4245 - E-46
- 20 4246 - E047
- 21 4247 - E-48
- 22 4248 - E-49
- 23 4252 - E-53
- 24 4253 - E-54
- 25 4254 - E-55
- 26 4255 - E-56
- 27 4256 - E-57
- 28 4257 - E-58
- 29 4258 - E-59
- 30 4259 - E-60
- 31 4260 - E-61
- 32 4261 - E-62
- 33 4264 - Supply Shed
- 34 4267 - E-68
- 35 4268 - E-69
- 36 4269 - E-70
- 37 4271 - E-72
- 38 4272 - E-73
- 39 4273 - Electric Propulsion
- 40 4280 - E-81
- 41 4281 - E-82

Developable Parcels

- Tier 1 - Most Developable
- Tier 2 - Demolition Required
- Tier 3 - Weak Infrastructure Links

Planning District Boundary

EDWARDS AIR FORCE BASE

Figure 2-6

North Base Planning District

2.2.6 South Base Planning District

One of the oldest parts of the installation, South Base was built in the early 1940s. Similar to North Base, South Base is a distinct, recognizable place at the installation, but it is better connected to the Flightline and Main Base Districts than the North Base (Figure 2-7). The northern boundary of South Base Planning District is the edge of the primary surface of the paved airfield. The district extends east and south to Rogers Dry Lakebed and is bounded on the west by Lancaster Boulevard.

In addition to being connected to the main runways via Taxiway G, South Base has its own airfield that includes Ramp 30 and Runway 6/24. It is connected to the Flightline Planning District by Taxiway G. On the north side of the small airfield are a group of facilities including Aircraft Dynamic Research Engineering, Electrical Engineering Research, propellant research laboratory and the Aero Club. To the southwest of the airfield is the munitions storage area, which includes a number of igloos and munitions shops. The district is connected to other parts of the installation via Hospital Road. Land use is predominantly industrial because of the munitions complex, but the district includes airfield, aircraft maintenance and operations and open space uses.

Relationship to Overall Future Development

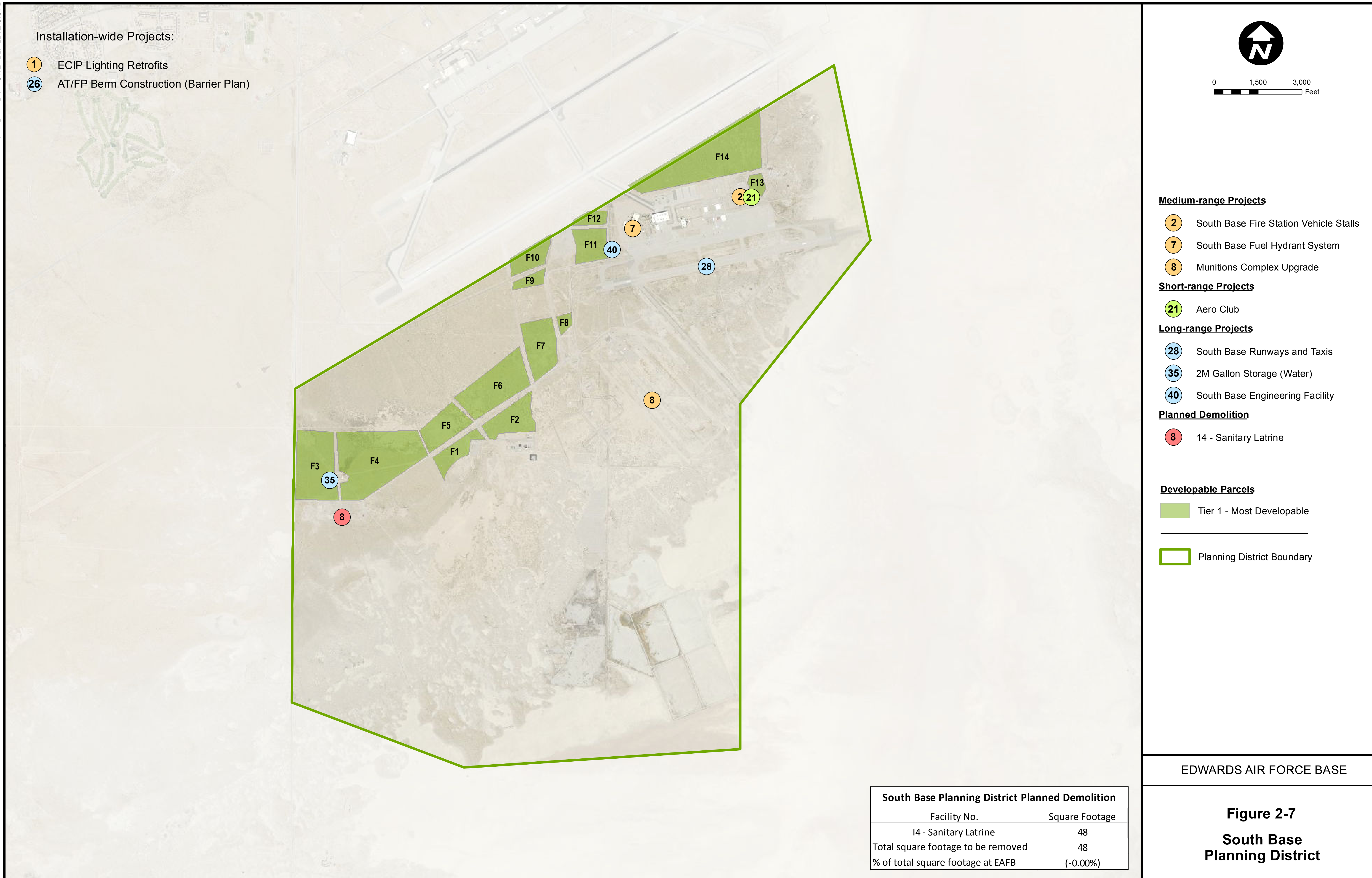
South Base is currently undergoing a transition to accommodate a new mission. Like the Flightline Planning District, South Base must continue to retain flexible buildings and infrastructure that can accommodate a range of missions. As the main storage area for munitions, the district also must upgrade its facilities to house modern types of munitions. There are some opportunities for development near the main airfield and near Runway 6/24, but most developable parcels are clustered around Hospital Road.

Constraints

South Base has a number of developmental constraints. Since it contains the munitions complex, there are a large number of ESQD arcs. Airfield constraints include the runway primary surface, CZs, and APZs. The district also lies on the same fault line that is under the Community Planning District.

Issues

- Munitions storage igloos and warehouses are old, the accompanying infrastructure has deteriorated and these facilities are inadequate to meet the evolving mission.
- Roadways, particularly in the munitions complex, are in poor condition.
- There is an ongoing need for flexible facilities to accommodate evolving test missions.



South Base Planning District Planned Demolition

Facility No.	Square Footage
I4 - Sanitary Latrine	48
Total square footage to be removed	48
% of total square footage at EAFB	(-0.00%)

EDWARDS AIR FORCE BASE

Figure 2-7

South Base Planning District

2.2.7 AFRL Planning District

The AFRL Planning District had its origins in 1947 when the Materiel Command located the new AF Experimental Rocket Engine Test Station on Leuhman Ridge, east of the Main Base (Figure 2-8). Like North Base and South Base, the AFRL is a distinct place within the installation. It consists of two separate areas: the facilities on Leuhman Ridge, and the facilities on the flat lands to the southeast. Facilities on Leuhman Ridge include electrical research laboratories, missile/space research testing facilities, test stands, equipment storage and a fire station. Below the ridge is the propulsion research laboratory, additional missile/space research testing, missile fuel storage, pads and hazardous materials storage.

All of the AFRL Planning District land use is designated as aerospace research and development.

Relationship to Overall Future Development

The AFRL Planning District is isolated from the rest of the installation and functions largely as an independent complex. Development that occurs here is typically not related to other functions on the installation. Future projects focus on upgraded infrastructure, additional earth covered magazines and a new test stand.

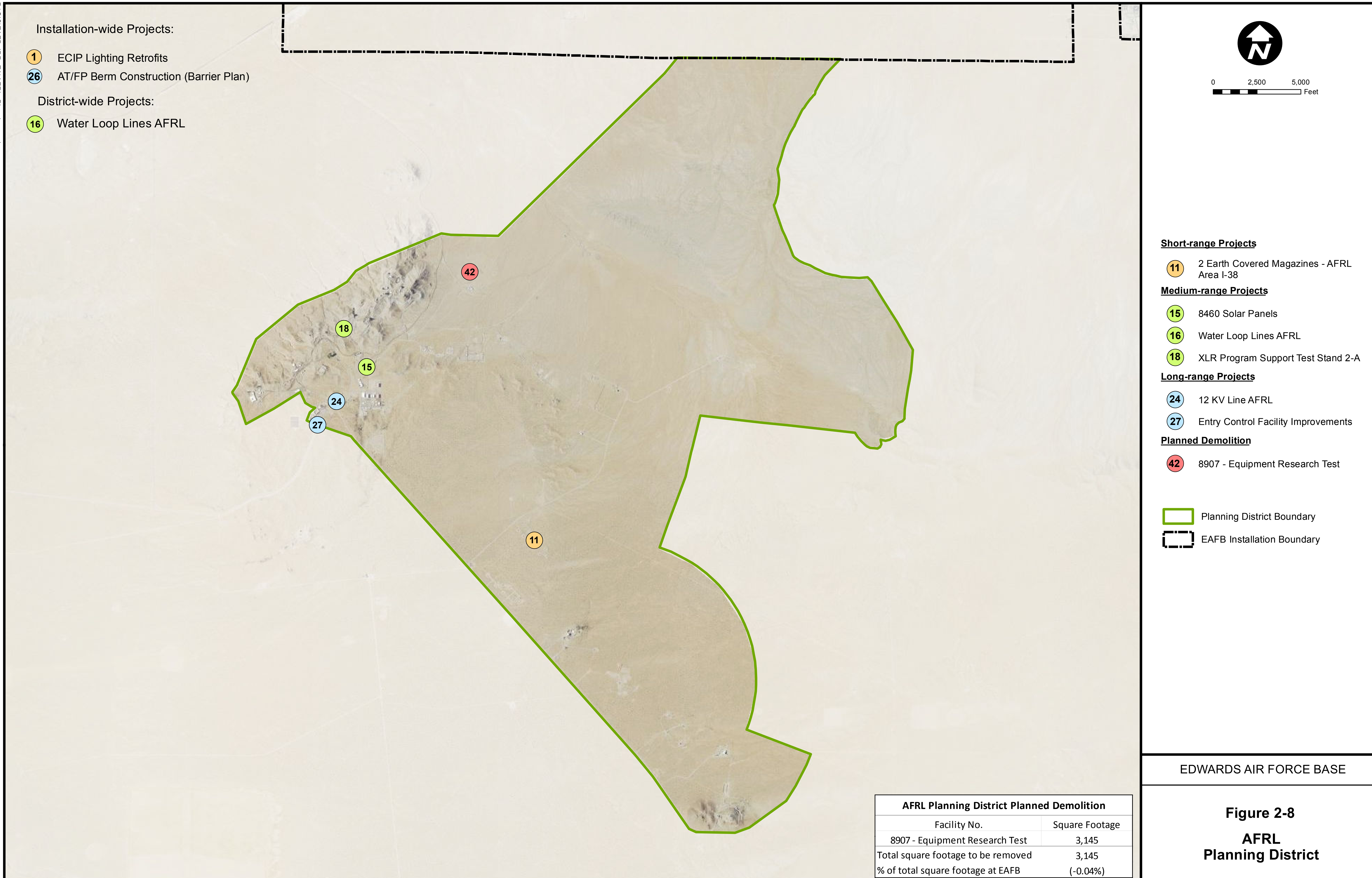
Constraints

There are many constraints to development within the AFRL Planning District. Most of the buildable area on Leuhman Ridge is already occupied and the remaining area has slopes that are too steep to be feasible for new construction (5 percent grade). The AFRL also has a large number of ESQD arcs and Leuhman Ridge is surrounded by three large contaminated groundwater plumes. There are 40 buildings that are eligible for NRHP listing as part of a historic district and there are documented populations of the Federally threatened desert tortoise in the area.

Issues

- The AFRL planning district includes part of the designated critical habitat for the desert tortoise
- The distance from Main Base necessitates that the AFRL has many of its own facilities such as a fire station and dining places, which creates an additional strain on maintenance resources

- The distance of the AFRL from the Main Base requires long infrastructure connections that are difficult to maintain
- The district has a large number of mothballed facilities, including many buildings which were built in the 1950s and are in poor condition
- Roads, parking and signage are in poor condition



AFRL Planning District Planned Demolition

Facility No.	Square Footage
8907 - Equipment Research Test	3,145
Total square footage to be removed	3,145
% of total square footage at EAFB	(-0.04%)

EDWARDS AIR FORCE BASE

Figure 2-8

AFRL Planning District

2.2.8 Special Use Planning District

The Special Use Planning District includes land that is outside the developed areas of the installation (Figure 2-9). The intent of this district is to preserve and regulate the special functions of these mostly-undeveloped lands, including military ranges, testing ranges and airfields. Sub-districts were developed to address the unique qualities of each different area.

Military Training Planning Sub-District

Located southeast of the West Gate, the Military Training Planning Sub-district is a restricted area reserved for range-related activities. Historically referred to as the "Prime Beef Training Area," the sub-district is home to the Combat Arms Training Maintenance (CATM) range, Rod and Gun Club, archery range, paintball field and a land navigation training area for SFS. East of the Rod and Gun Club is Camp Corum used by SFS for training.

Rogers Dry Lakebed Planning Sub-District

Rogers Dry Lakebed is the location of 15 runways. Preserving the natural integrity of the lakebed's surface crust is a top priority, as is complying with Rogers Dry Lakebed's status as a National Historic Landmark. The boundary of the Rogers Dry Lakebed Planning Sub-district is a generalized polygon around the lakebed edges. Its land use is airfield, but it is entirely unpaved and undeveloped.

Rosamond Dry Lakebed Planning Sub-District

Rosamond Dry Lakebed is one of the first landmarks that people see when arriving at the installation through the West Gate. Like Rogers Dry Lakebed, it is also used as an airfield but in a much more limited capacity.

Testing and Evaluation North Planning Sub-District

Testing and Evaluation North Planning Sub-district includes the West Gate, a number of utility buildings, solid waste disposal, hazardous material storage and outdoor recreation facilities such as the stables. Its airspace is also used for spin testing and has historically been a parachute drop zone training site. When the testing schedule permits, much of the area is available for outdoor recreation uses such as hunting and the use of ORVs. The land use of this district is RDT&E. Future projects are scheduled for the West Gate area and there has been discussion about a solar development enhanced use lease (EUL) project in the far northwest area.

Testing and Evaluation South Planning Sub-District

The Testing & Evaluation South Planning Sub-district surrounds areas of Rosamond Dry Lakebed, the Military Training District and Buckhorn Dry Lakebed, and borders the southern boundary of the installation. This sub-district is used for testing and evaluation, but also functions as a buffer for the installation. Piute Ponds, located in the southwest corner of the sub-district, is a significant feature and can be used seasonally for hunting as permitted by the testing schedule. The sub-district is also home to Branch Memorial Park near the South Gate.

Rich Road Planning Sub-District

Located between Rogers Dry Lakebed and the AFRL, the Rich Road Planning Sub-district acts as a safety buffer between the two districts and is also used for testing and evaluation. Its major feature is Rich Road, which connects Route 58 (via 20 Mule Team Road) to Mercury Boulevard and the south side of the installation. There is no gate at Rich Road and the public can use the roadway as a shortcut through the installation to the city of Lancaster. During testing events, the roadway is temporarily closed. Land use in the sub-district is designated as RDT&E, and most of the area is used as a spin test area and/or a training jettison area. The sub-district is also used for land sailing outdoor recreation.

Precision Impact Range Area Planning Sub-District

The PIRA is the mission-critical site of numerous weapons test targets, including Edwards AFB’s only live-ordnance target. This function requires a safety buffer of approximately 56 square miles. The range supports over six missions daily and must have a safe, sterile environment for operations.

Relationship to Overall Future Development

The Special Use Planning District should remain mostly undeveloped. Only limited development should occur in these areas and must be compatible with existing functions of the sub-districts. Across the Special Use District, only four permitted uses are allowed, varying by sub-district: aircraft testing and evaluation range, military training range, outdoor recreation, historic preservation and open space.

Constraints

Military Training Planning Sub-District

Most of the district is constrained by the Safety Distance Zone (SDZ) created by the gun ranges. This area has also been identified as a place where archaeological resources are likely to be found.

Rogers Dry Lakebed Planning Sub-District

Development is completely constrained in the sub-district because of the need to maintain the lakebed soil's natural condition and to avoid development in a floodplain (Rogers Dry Lakebed is within a 100-year floodplain). Additionally, the sub-district is constrained by the spin test area that encompasses the northern half of the lakebed, the lakebed's status as a Natural Historic Landmark, and the identification of the north side of the lakebed as a place where archaeological resources likely exist.

Rosamond Dry Lakebed Planning Sub-District

The lakebed is completely constrained for future development, preserving its ability to function as an airfield. Although it is not as frequently used as Rogers Dry Lakebed, maintaining the natural integrity of the lakebed's surface is key to maintain its status as an alternate landing site. In addition, development is prohibited in a floodplain (Rosamond Dry Lakebed is within a 100-year floodplain). The eastern side of the lakebed is also a highly likely site of archaeological resources.

The northern edge of this sub-district is the site of a proposed utility corridor, which should be considered in future development scenarios.

Testing and Evaluation North Planning Sub-District

This sub-district has a number of development constraints, including the steep slopes of Bissell Hills and the use of this sub-district for spin testing. Some parts of the district contain desert tortoise critical habitat and a substantial portion of the district has been identified as having a high likelihood of containing archaeological resources. This sub-district is also the site of six proposed utility corridors that may need to be considered in future development scenarios.

Testing and Evaluation South Planning Sub-District

The sub-district has some constraints to development. There are a significant number of archaeological resources in the area east of Rosamond Dry Lakebed, areas of the Buckhorn Dry Lakebed and land around Lancaster Boulevard. This sub-district is also the site of a proposed utility corridor that should be considered in future development scenarios.

Rich Road Planning Sub-District

The most significant constraint in the sub-district is its testing function and necessity to keep the area undeveloped. There is also evidence of desert tortoise critical habitat and a high likelihood of archaeological resources in the southern portion of the sub-district. This sub-district is also the site of a proposed utility corridor that should be considered in future development scenarios.

Precision Impact Range Area Planning Sub-District

Most of this sub-district is an active range, and cannot be developed without interfering with the 412th Test Wing's testing mission. In addition, there are multiple topographical constraints, a high occurrence of desert tortoise critical habitat and a high likelihood of archaeological resources. The northern edge of this sub-district is the site of two proposed utility corridors that should be considered in future development scenarios.

Issues

Military Training Planning Sub-District

- The CATM Range D SDZ must expand to accommodate a new EOD requirement to qualify for the 50-caliber M107

Rogers Dry Lakebed Planning Sub-District

- Rogers Dry Lakebed is experiencing a breakdown of its surface and will require measures to bring the lakebed back to a sustainable condition

Rosamond Dry Lakebed Planning Sub-District

- The lakebed hydrology must be monitored to maintain the soil's natural surface
- Trespassing over the lakebed surface by unauthorized users must be controlled
- Rosamond Boulevard has flooded where it crosses the lakebed
- A proposed utility corridor across the northern edge of the sub-district could constrain development

Testing and Evaluation North Planning Sub-District

- Testing uses must be balanced with recreational uses
- Proposed utility corridors could constrain development

Testing and Evaluation South Planning Sub-District

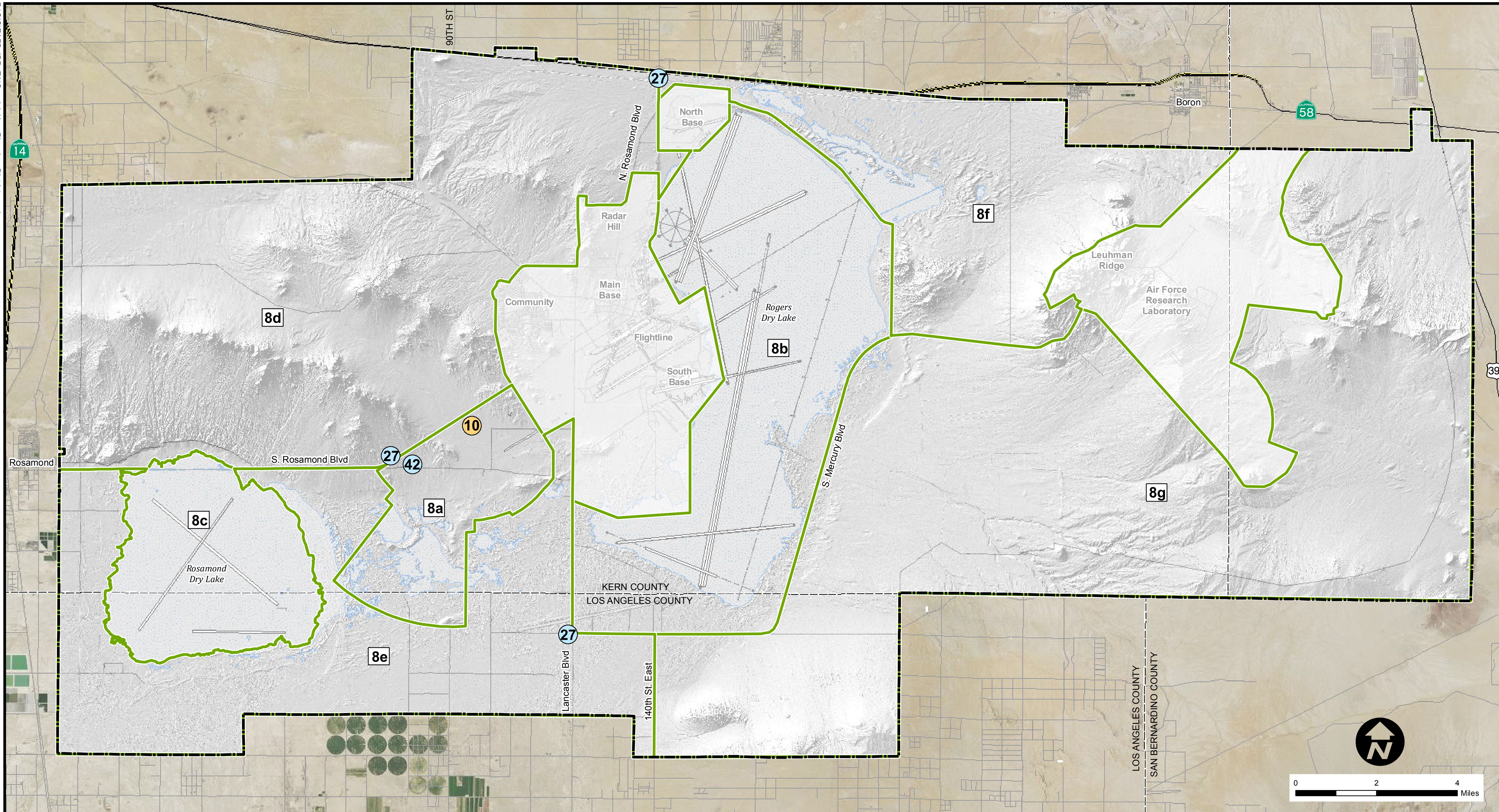
- Piute Ponds is managed as marshlands
- The CATM Range SDZ will extend into the district in the future
- A proposed utility corridor could constrain development
- Branch Memorial Park is an isolated amenity

Rich Road Planning Sub-District

- The public has access to Rich Road, which is a security issue
- A proposed utility corridor in the sub-district could constrain development

Precision Impact Range Area Planning Sub-District

- Two proposed utility corridors are located in the northeast of the sub-district
- Encroachment must be aggressively managed to maintain the necessary safety buffer for testing operations
- The critical habitat for the desert tortoise on Edwards AFB is primarily located in the PIRA and the AFRL areas
- Current utility and highway easements.



Short-range Projects

10 Small Arms Range Firing Platforms

Long-range Projects

42 Museum Relocation

27 Entry Control Facility Improvements

Planning District Boundary

EAFB Installation Boundary

SPECIAL USE PLANNING DISTRICT

- 8a Military Training Planning Sub-district
- 8b Rogers Dry Lakebed Planning Sub-district
- 8c Rosamond Dry Lakebed Planning Sub-district
- 8d Testing & Evaluation North Planning Sub-district
- 8e Testing & Evaluation South Planning Sub-district
- 8f Rich Road Planning Sub-district
- 8g PIRA Planning Sub-district

EDWARDS AIR FORCE BASE

Figure 2-9

Special Use Planning District Sub-Districts

2.3 ALTERNATIVE 1: HIGH INTENSITY DEVELOPMENT ALTERNATIVE

2.3.1 Overview

Although the IDP lays out long-term, maximum buildout in each Planning District, it is unlikely that all identified projects would be implemented in the next 5 to 10 years, given the uncertainties of funding and evolving mission requirements. However, in order to provide a worst-case environmental analysis that allows for flexibility in the types and numbers of projects that may be undertaken, a high-intensity development alternative is proposed (Alternative 1). For this alternative, a select list of projects (or types of projects) that are most likely to occur or represent the types of development that could occur in each Planning District have been selected for inclusion in the environmental analysis. Table 2-1 provides an overview of the types of developments considered in each planning district and provides a sum total (where applicable) of each type of development.

In particular, the following basic assumptions have been made in identifying projects to include as part of the Alternative 1:

- The size or square footage of facilities shown is a not to exceed figure, and could occur in one or multiple buildings;
- Renovation of existing structures or facilities would be undertaken where possible;
- Consolidation of functions within new or renovated structures would be undertaken where possible;
- No significant increases in personnel are expected;
- Impacts would be spread out over 5 to 10 years;
- No projects are proposed in floodplain areas; and
- Avoidance of existing restoration sites (contamination plumes and monitoring wells) where possible.

Alternative 1 is to include a high level of development at Edwards AFB. Projects are identified below for each planning district in Sections 2.3.2 through 2.3.9.

Table 2-1
Overview of High Intensity Development Alternative Projects

	DEVELOPMENT TYPE									
PLANNING DISTRICT	**Facility Space (square feet)**	**Parking with Solar (square feet)**	**Demolish Building Space (square feet)**	**Construct/ Upgrade Utilities Infrastructure**	**Perimeter Fencing**	**Aircraft Parking/ Ramp/ Apron (square feet)**	**Construct/ Upgrade Roads (linear feet)**	**Install Sidewalks/ Running and Biking Trails (miles)**	**Install Xeriscaping/ Landscaping**	**Miscellaneous**
Main Base	400,000	137,000	10,000	Yes	NA	NA	Yes	5 mi sidewalks 10 mi trails	Yes	Enlarge 4 switching terminals
Flightline	250,000	150,000	70,000	Yes	Perimeter fence 50 feet from building	330,000	Yes	Yes	Yes	Renovate/ maintain taxiway, ramp, pads, apron
Community	100,000	30,000	6,500	Yes	NA	NA	Yes	5 mi sidewalks 10 mi trails	Yes	--Expand Military Family Housing --Construct recreation areas and shade structures
Radar Hill	80,000	NA	2,500	Yes	Perimeter fence 50 feet from building	NA	1,000	Yes	Yes	--Develop radar sites --Expand range diameter
North Base	360,000	NA	20,000	Yes	Perimeter fence 50 feet from building	540,000	3,100	Yes	Yes	--Expand ramps --Future facilities
South Base	340,000	NA	100	Yes	Perimeter fence 50 feet from building	468,000	Yes	Yes	Yes	Support new mission
Air Force Research Laboratory	30,000	150,000	33,200	Yes	Perimeter fence 50 feet from building	NA	Yes	Yes	Yes	Rehabilitate test stands
Special Use	30,000	NA	6,000	Yes	NA	NA	NA	NA	NA	Enhanced Use Lease opportunities
TOTAL	**1,590,000**	**467,000**	**148,000**	**Unknown**	**Unknown**	**1,338,000**	**4,100**	**10 mi sidewalks 20 mi trails**	**Unknown**	**Unknown**

2.3.2 Main Base Planning District Projects

The following projects in the Main Base Planning District are included as part of the High-Intensity Alternative:

- Construct up to 400,000 square feet of facility space (examples include a gymnasium/ warrior fitness center, warehouse, new dormitory, distributed telecommunication facility) [for a point of reference for scale, a Costco or other large box store are typically about 150,000 square feet];
- Construct up to 137,000 square feet of vehicle parking, including solar roofs;
- Construct utility infrastructure, which may include new or upgraded utility connections;
- Demolish up to 10,000 square feet of building space;
- Install xeriscaping/landscaping;
- Install up to 5 miles of sidewalks;
- Install up to 10 miles of running and biking trails or paths; and
- Enlarge remote switching terminals (four at 1,284 square feet each).

2.3.3 Flightline District Projects

The following projects in the Flightline Planning District are included as part of the High-Intensity Alternative:

- Construct up to 250,000 square feet of facility space (examples include a fire station and hangar);
- Construct up to 150,000 square feet of vehicle parking, including solar roofs;
- Construction of utilities infrastructure, which may include new or upgraded utility connections;
- Install perimeter fence 50 feet from building;
- Demolish up to 70,000 square feet of building space;
- Construct up to 330,000 square feet of aircraft parking ramp/apron;
- Renovate/maintain taxiway, ramp, pads, apron (i.e., resealing, rubber removal, etc.); and
- Install xeriscaping/landscaping.

2.3.4 Community Planning District Projects

The following projects in the Community Planning District are included as part of the High-Intensity Alternative Expansion of Military Family Housing (Note: NEPA compliance would be

required for actions taken within the privatized housing area and would be addressed by the Housing Privatization Owner);

- Construct or upgrade up to 100,000 square feet of facility space (examples include a new golf course facility);
- Construct up to 30,000 square feet of vehicle parking, including solar roofs;
- Construct utilities infrastructure, which may include new or upgraded utility connections;
- Demolish up to 6,500 square feet of warehouse space;
- Construct recreation areas/parks, shade structures/pavilions;
- Install xeriscaping/landscaping;
- Install up to 5 miles of sidewalks; and
- Install up to 10 miles of running and biking trails or paths.

2.3.5 Radar Hill Planning District Projects

The following projects in the Radar Hill Planning District are included as part of the High-Intensity Alternative:

- Construct up to 80,000 square feet of facility and private vehicle parking;
- Construct utilities infrastructure;
- Demolish up to 2,500 square feet of old bulk fuels facilities (tanks, pipeline, etc.);
- Construct a 1,000-linear foot graded access road;
- Install perimeter fence 50 feet from building;
- Expand range diameter from current 170,000 square feet to 174,000 square feet;
- Develop radar sites by constructing pads/walls/roads for towers/antennas: construct 3 towers in previously disturbed area (3 pads per tower, with each pad 12 feet by 12 feet; total graded area per tower is 200 estimated at square feet); and
- Install xeriscaping/landscaping.

2.3.6 North Base Planning District Projects

The following projects in the North Base Planning District are included as part of the High-Intensity Alternative:

- Construct up to 360,000 square feet of facility space (including a maintenance area);
- Construct up to 540,000 square feet of aircraft parking ramps each adjacent to a hangar;
- Construct expanded/upgraded utilities infrastructure, which may include new or upgraded utility connections;

- Demolish up to 20,000 square feet of building space;
- Install xeriscaping/landscaping;
- Pave/expand Lakeshore Drive by 3,100-linear feet;
- Install perimeter fence 50 feet from building; and
- Expand ramps.

2.3.7 South Base Planning District Projects

The following projects in the South Base Planning District are included as part of the High-Intensity Development:

- Construct up to 340,000 square feet of facility space (examples include a hangar and munitions bunkers);
- Expand/upgrade utilities infrastructure, which may include new or upgraded utility connections or a hydrant system;
- Install perimeter fence 50 feet from building;
- Demolish up to 100 square feet of facility space (sanitary latrine);
- Construct up to 468,000 square feet of aircraft parking and apron; and
- Install xeriscaping/landscaping.

2.3.8 AFRL Planning District Projects

The following projects in the AFRL Planning District are included as part of the High-Intensity Alternative:

- Demolish and reconstruct one 30,000 square foot facility (in the same place);
- Rehabilitate test stands (i.e., replace/repair concrete slabs, sidewalks, infrastructure, etc.);
- Construct up to 150,000 square feet of vehicle parking, including solar roofs;
- Construction of utilities to the site;
- Install perimeter fence 50 feet from each facility/test stand and their respective access roads; and
- Demolish up to 3,200 square feet of building space.

2.3.9 Special Use Planning District Projects

The following projects in the Special Use Planning District are included as part of the High-Intensity Proposal:

- *Military Training Sub-District:*
  - Demolish old firing platform (approximately 6,000 square feet) and construct new one with some below ground level and some above (16 feet by 20 feet worst case with 15 foot plus block wall and canopy)
- *Rogers Dry Lake Sub-District:* no known future construction;
- *Rosamond Dry Lake Sub-District:* no known future construction;
- *Test and Evaluation North Sub-District:*
  - Entry Control Point (ECP) (access gate) improvements and/or expansion of up to 10,000 square feet of facility space
  - EUL opportunities
    - Designate access/maintenance roads
    - Construct utilities infrastructure (water and electricity)
- *Test and Evaluation South Sub-District:*
  - ECP improvements and/or expansion of up to 10,000 square feet of facility space
  - EUL opportunities
    - Designate access/maintenance roads
    - Construct utilities infrastructure (water and electricity)
- *Rich Road Sub-District:*
  - ECP improvements and/or expansion of up to 10,000 square feet of facility space
- *PIRA Sub-District:* no known future construction

2.4 ALTERNATIVE 2: BASIC MAINTENANCE ALTERNATIVE

With Alternative 2, no new structures or facilities would be built. It would consist of maintaining existing facilities so that they are kept operational to prevent mission degradation. This could include renovation or repurposing of existing structures to configure facilities to meet ever changing missions and further enhance planning district efficiency. It may also include consolidation of functional areas and moving people around according to function or organization.

2.5 ALTERNATIVE 3: NO ACTION ALTERNATIVE

The CEQ regulations require consideration of the No Action Alternative for all proposed actions. The No Action Alternative serves as a baseline against which the impacts of the other alternatives can be compared and consequently it is carried forward for further evaluation in this EA. The No Action Alternative would be "no change" from current practices (status quo), or continuing with the present course of action until that action has changed. On average, over the past 10 years, approximately 2 to 3 major projects have been constructed at Edwards AFB each year. Under the No Action Alternative, this minimal level of development would continue and future installation development projects would continue to be evaluated on an individual basis without regard to planning district efficiency, current capacity or functionality.

2.6 SUMMARY OF ENVIRONMENTAL IMPACTS

Table 2-2 presents a summary of anticipated environmental impacts for all alternatives.

Table 2-3 presents a compilation of the avoidance and minimization measures proposed to reduce impacts to a level that is not significant.

Table 2-2
Summary of Potential Environmental Impacts

Resource	Alternative 1 High Intensity Development	Alternative 2 Basic Maintenance	Alternative 3 No Action
Air Quality & Greenhouse Gases	Construction and operational emissions would be well below significance thresholds and would not be significant. Incorporation of minimization measures MM AIR-1 through MM AIR-13 to minimize fugitive dust emissions and to ensure compliance with state off-road regulations would further reduce air quality and greenhouse gas emissions.	Fewer impacts than Alternative 1. No mitigation required.	No change from current conditions. Impacts similar to Alternative 1 but to a lesser effect. Incorporation of MM AIR-1 through MM AIR-13 would further reduce impacts.
Cultural & Paleontological Resources	Demolition and construction, and other activities associated with Alternative 1 could affect cultural resources at Edwards AFB. In areas not previously surveyed, a cultural resources survey should be performed prior to the onset of the construction, demolition, installation, or enlargement, with Formal evaluation conducted as warranted. While avoidance is the preferred treatment for cultural resources, avoidance is not always feasible. In such situations, a cultural resources monitor may be present for the duration of the ground disturbance or renovations. However, with incorporation of MM CUL-1, potential impacts to cultural resources would be reduced to a less than significant level.	Fewer impacts than Alternative 1. No mitigation required.	No change from current conditions. Implementation of MM CR-1 would further reduce impacts.
Geology & Soils	Construction of projects would not damage or destroy existing landforms found within the Planning Districts. Most development would occur in areas adjacent to existing development or in areas previously disturbed. Any project within any of the Planning Districts has the potential to be impacted by the geology or soils that may become unstable during a seismic event. While there are no known active faults on Edwards AFB, active faults are found with the region. Impacts would be minimized by implementation of standard construction methods and, where applicable, implementation of MM GEO-1. Construction of projects identified in Alternative 1 have a high potential for soil loss due to wind erosion during for all planning	Fewer impacts than Alternative 1. No mitigation required.	No change from current conditions. Impacts similar to Alternative 1 but to a lesser effect. Incorporation of MM GEO-1 through MM GEO-5 would further reduce impacts.

Table 2-2
Summary of Potential Environmental Impacts

Resource	Alternative 1 High Intensity Development	Alternative 2 Basic Maintenance	Alternative 3 No Action
	districts at Edwards AFB. Once construction is complete, potential loss of soil due to wind or storm water erosion would not likely exceed current developed conditions found throughout much of Edwards AFB. Impacts would be less than significant with implementation of MM GEO-2 through MM GEO-5.		
Hazardous Materials & Hazardous Waste	Construction and operation of projects associated with Alternative 1 would not mobilize existing contaminants associated with identified OUs at Edwards AFB in groundwater or soil, or expose workers to contaminated soils or groundwater. No adverse impacts related to ERP would be expected and no mitigation is required. The use of hazardous materials during development under Alternative 1 is anticipated to be limited to construction vehicle maintenance activities and construction materials. These materials would be required to be properly contained, manifested, and managed in accordance with all federal, state, and local regulations, AFIs, and DoD Directives. No long-term change in existing hazardous materials and hazardous waste management would occur as a result of any development. All federal, state, and local environmental laws would continue to be observed, as well as preventative measures contained in the Edwards AFB Hazardous Waste Management Plan (HWMP). Implementation of MM HAZ-1 would further reduce adverse impacts related to hazardous materials and waste to a level that is not significant.	Fewer impacts than Alternative 1. Incorporation of MM HAZ-1 would ensure impacts would not be significant.	No change from current conditions. Impacts similar to Alternative 1 but to a lesser extent. Incorporation of MM HAZ-1 would further reduce impacts.
Infrastructure	In general, the infrastructure systems at Edwards AFB (electricity, natural gas, wastewater, stormwater, roadway network) are functioning at acceptable levels. Implementation of MM INF-1 and MM INF-2 would help to reduce impacts to a level that is not significant.	Fewer impacts than Alternative 1. No mitigation required.	No change from current conditions. Impacts similar to Alternative 1 but to a lesser effect. Incorporation of MM INF-1 and MM INF-2 would further reduce impacts.

Table 2-2
Summary of Potential Environmental Impacts

Resource	Alternative 1 High Intensity Development	Alternative 2 Basic Maintenance	Alternative 3 No Action
Land Use	No significant effects on land use would occur from implementation of the IDP as future land use is not expected to change. No mitigation is required.	Fewer impacts than Alternative 1. No mitigation required.	No change from current conditions. No mitigation required.
Natural Resources	Potential direct and indirect impacts to general vegetation and wildlife communities, as well as sensitive species and habitats could occur primarily in areas where ground disturbing activities may occur. Implementation of MM BIO-1 through MM BIO-4 would reduce impacts to a less than significant level.	Fewer impacts than Alternative 1. No impacts are expected to general vegetation and wildlife so no mitigation required. Potential impacts to nesting birds would be avoided or minimized by implementation of MM BIO-3.	No change from current conditions. Impacts similar to Alternative 1 but to a lesser extent. If a project were proposed on native vegetation, implementation of MM BIO-1 through MM BIO-3 would reduce impacts to a less than significant level. Potential impacts to nesting birds would be avoided or minimized by implementation of MM BIO-3.
Noise	Construction noise would be primarily from construction vehicles and equipment. Impacts would be short term and temporary. Implementation of MM NOI-1 would reduce impacts to a less than significant impact. Operational noise could come from additional trips but would not be significant.	Fewer impacts than Alternative 1. Incorporation of MM NOI-1 would ensure impacts would not be significant.	No change from current conditions. Impacts similar to Alternative 1 but to a lesser extent. Implementation of MM NOI-1 would further reduce impacts.
Socioeconomics	The regional economy would benefit from increased expenditures incurred at Edwards AFB from construction activities for new or	Fewer impacts than Alternative 1.	No change from current conditions.

Table 2-2
Summary of Potential Environmental Impacts

Resource	Alternative 1 High Intensity Development	Alternative 2 Basic Maintenance	Alternative 3 No Action
	renovated facilities. Under this alternative, impacts would be spread out over five to ten years and no significant increases in personnel are expected. Construction workers are anticipated to come from the local area with companies primarily utilizing their existing employees. No adverse impacts are anticipated and no mitigation is proposed.	No mitigation required.	No mitigation required.
Water Resources	Construction of potential projects that involve ground disturbing activities has the potential to impact surface water quality or result in erosion. New development is not proposed in flood hazard areas. Implementation of MM HYD-1, MM HYD-2 and MM HYD-3 would reduce impacts to a less than significant level.	Fewer impacts than Alternative 1. No mitigation required.	No change from current conditions. Impacts similar to Alternative 1 but to a lesser extent. Incorporation of MM HAZ-1 through MM HAZ-3 would further reduce impacts.

Table 2-3
Summary of Minimization Measures

Resource	Measures to Minimize or Reduce Impacts
Air Quality & Greenhouse Gases	**MM AIR-1:** Project activities shall comply with all applicable rules and regulations as identified in AFI 32-7040, *Air Quality Compliance and Resource Management* (2014). **MM AIR-2:** The project shall comply with all applicable EKAPCD, MDAQMD or AVAQMD rules and regulations and obtain the necessary air quality permits. Emissions from permitted devices and activities must be tracked and reported to the CARB, the appropriate air district and the USEPA. Air quality permits, if required, shall be coordinated through the Environmental Management Division at Edwards AFB. The Environmental Management Division is the lead agency for the application and maintenance of air quality permits on Edwards AFB. Very few, if any, air quality permits would be required for this project as the majority of emissions will be due to mobile sources. **MM AIR-3:** Any internal combustion engine subject to National Emissions Standards for Hazardous Air Pollutants (NESHAP) or New Source Performance Standards requirements must be permitted by the local AQMD/APCD. Based on recent revisions to the Reciprocating Internal Combustion Engine NESHAP, all stationary generators are now subject to the regulation regardless of size; this in turn makes them subject to permitting requirements. Permitting is also required (retroactively) for any non-road engine that fails the indicia of portability (i.e., exceeds the 12-month time limit). If such equipment is to remain on base less than 45 calendar days, a written exemption must be obtained from the local air agency. **MM AIR-4:** The proposed project shall not discharge from any source whatsoever, such quantities of air contaminants or other material that would: cause injury, detriment, nuisance or annoyance to any considerable number of persons or to the public; endanger the comfort, repose, health or safety of any such persons or the public; or cause or have a natural tendency to cause injury or damage to business or property. **MM AIR-5:** All earthwork activities shall be planned and conducted to minimize the duration that soils would be left unprotected. The extent of the area of disturbance necessary to accomplish the project shall be minimized. Exposed surfaces shall be periodically sprayed with water. **MM AIR-6:** Visible emissions (e.g., dust or smoke) from the proposed projects shall not exceed the limitations as outlined by the local air district. **MM AIR-7:** Apply water or dust suppressants to roads and open areas where dust is being generated. If winds produce excessive visible emissions, erect wind barriers. Do not grade or till compacted dirt without applying water or dust suppressant. **MM AIR-8:** Discontinue grading and other ground-disturbing activities at wind speeds exceeding 25 miles per hour. **MM AIR-9:** All vehicles transporting fill material or debris shall be covered to reduce $PM_{2.5}$ and PM_{10} emissions during transport.

Table 2-3
Summary of Minimization Measures

Resource	Measures to Minimize or Reduce Impacts
	MM AIR-10: Temporary coverings must be installed over open storage piles. **MM AIR-11:** All mechanical and construction equipment shall be kept in good working order according to applicable technical orders and the manufacturer's equipment maintenance manuals to reduce emissions to acceptable levels. **MM AIR-12:** The following dust control measures will be implemented during land preparation (i.e., clearing, grading, etc.), excavation and/or post-construction: • All soil excavated or graded should be sufficiently watered to prevent excessive dust. Watering should occur as needed with complete coverage of disturbed soil areas. Watering should be a minimum of twice daily on unpaved/untreated roads and on disturbed soil areas with active operations. • All clearing, grading, earth moving and excavation activities should cease during periods of winds greater than 20 miles per hour (mph) (averaged over one hour), if disturbed material is easily windblown or when dust plumes of 20% or greater opacity impact public roads, occupied structures or neighboring property. • All fine material transported off site should be either sufficiently watered or securely covered to prevent excessive dust. • All haul trucks should be required to exit the site via an access point where a gravel pad or grizzly has been installed. • Stockpiles of soil or other fine loose material shall be stabilized by watering or other appropriate method to prevent wind-blown fugitive dust. • Once clearing or grading has ceased, all inactive soil areas within the project area should either be seeded and watered until plant growth is evident, treated with a dust palliative or watered twice daily until soil has sufficiently crusted to prevent fugitive dust emission. • On-site vehicle speed should be limited to 15 mph. • All areas with vehicle traffic should be paved, treated with dust palliatives or watered a minimum of twice daily. • Streets adjacent to the project site should be kept clean and accumulated silt removed. • Revegetation/restoration shall be required based on the level of disturbance created from project activities. Revegetation/restoration shall be in accordance with the *Edwards Air Force Base Revegetation Plan* (AFFTC/EM 1994).

Table 2-3
Summary of Minimization Measures

Resource	Measures to Minimize or Reduce Impacts
	MM AIR-13: The following measures should be implemented to control construction vehicle tailpipe emissions: • Properly maintain and tune all internal combustion engine powered equipment; • Require employees and subcontractors to comply with the ARB idling restrictions for compression ignition engines; and • Use CARB diesel fuel.
Cultural Resources	**MM CUL-1:** Avoidance is the preferred treatment for NRHP-eligible cultural resources. If avoidance is not possible, then resources will need to be evaluated prior to any development and construction within a proposed Planning District, and any potentially NRHP-eligible resources will require resolution of the adverse effects. Construction monitoring may be implemented in areas where subsurface cultural resources are anticipated. Additional site-specific mitigation may be implemented prior to development in any of the Planning Districts. In addition, any projects developed for a proposed Planning District should be coordinated with the Base Archaeologist and/or Base Architectural Historian. This coordination will address resource-specific mitigation, which may be further developed through consultation with the California SHPO or through Native American consultation.
Geology and Soils	The following minimization measures would reduce potential project impacts from a naturally-occurring seismic event and potential wind or storm water erosion of soils. Not all of these measures will be applicable to all projects. Each project will need to be evaluated to determine which is appropriate. **MM GEO 1:** Prior to final project design, a geotechnical study should be conducted by a qualified geologist/engineer to identify site-specific geologic conditions and potential geologic hazards in sufficient detail to support sound engineering. Appropriate mitigations for identified geological hazards would be identified in the geotechnical study. **MM GEO-2:** Prepare and implement a construction Storm Water Pollution Prevention Plan (SWPPP) prior to the commencement of soil disturbance activities associated with construction. **MM-GEO-3:** Use non-hazardous dust suppression palliatives approved by Edwards AFB and water on an as-needed basis to suppress wind-blown dust generated at the site during construction. Dust suppression palliatives are materials that work by either agglomerating the fine particles, adhering/binding the surface particles together, or increasing the density of the surface material. **MM GEO-4:** Implement erosion control measures during construction, including stabilization of construction areas, employing a concrete wash out area, as needed, and tire washes near the entrance to existing roadways; and **MM GEO-5:** Install silt fences for erosion control during construction.

Table 2-3
Summary of Minimization Measures

Resource	Measures to Minimize or Reduce Impacts
Hazardous Materials and Hazardous Waste	**MM HAZ-1:** Project activities shall comply with all applicable rules and regulations as identified in AFI 32-7086, *Materials Management* (2015) and AFI 32-7042, *Waste Management* (2014).
Infrastructure	**MM INF- 1:** Evaluate construction projects that could potentially affect stormwater flows and provide appropriate drainage improvements before project initiation. **MM INF-2:** Complete an updated transportation network study of the entire Base to assess current conditions, analyze LOS, condition of roads, and key intersections.
Land Use	No minimization or mitigation measures would be required.
Natural Resources	**MM BIO-1: Project Siting and Adherence to Base Minimization Measures** Projects would be sited preferentially as follows: 1. Within areas covered by engineered surfaces such as asphalt or gravel. 2. Within already disturbed areas where native vegetation has been removed (bare soil or non-native vegetation) 3. Within areas of native habitat, and only when the project cannot be sited elsewhere. The Basewide Biological Opinion (8-8-814-F-14; USFWS 2014 – found in Appendix F with terms and conditions listed on pages 7 through 11) shall be adhered to and the Base Minimization Measures will be followed to the extent possible and used during pre-project planning to assess and avoid potential impacts to biological resources. **MM BIO-2: Project Review/Pre-Construction Survey and Monitoring as Necessary** All projects would be submitted during the planning phases (i.e., 30% design) to the Edwards AFB Environmental Management office for review by a biologist familiar with the natural resources on the Base. If the biologist determines that the location and nature of the project does not require pre-construction surveys and/or monitoring, the project will proceed without such activities. If a pre-construction survey is deemed prudent, it will be conducted by a desert tortoise Authorized Biologist approved by the U.S. Fish and Wildlife Service (USFWS). If a preconstruction survey determines that monitoring is required, it will conducted by a desert tortoise Authorized Biologist approved by the USFWS. Other reasonable and prudent avoidance or minimization measures may be deemed necessary by Environmental Management office review. If deemed necessary by the biological review, biological monitors will be employed for the project to ensure that project activities: • Use only personnel who have completed natural resources training, which can be conducted in the field as necessary;

Table 2-3
Summary of Minimization Measures

Resource	Measures to Minimize or Reduce Impacts
	• Comply with all terms and conditions of the basewide Biological Opinion (8-8-14-F-14; USFWS 2014 – found in Appendix F with terms and conditions listed on pages 7 through 11), or other permitting related to that activity; • Do not result in the violation of any state and federal Endangered Species Acts through the unauthorized take of a listed species; or • Document all such training and compliance activity for inclusion in permitting reports as required. **MM BIO-3: Avoidance of MBTA Violation** If possible, schedule all work outside of the nesting season (generally February through August but largely depending on seasonal weather patterns). If work is to occur during nesting season, conduct a nesting survey of the work area both within one week of the start of construction to identify potential nesting issues that can be avoided, and again immediately prior (within 24 hours) to the initiation of construction or demolition activities. If a nest is found during work activities, work will stop in the immediate area of the nest and a biologist will be called to inspect the nest and determine the best course of action, including the potential of establishing temporary avoidance areas until nesting is completed. Projects will be checked for nesting activities throughout construction or demolition activities at intervals determined by the project biologist and based on the type and location of the activities. Nest monitoring will be focused within the most common breeding season of February through August but may also be necessary in other seasons and will be conducted as determined for a specific project based on the project biologist's recommendations related to the nature and specific location of the activities. **MM BIO-4: Management of Invasive Plants** During any project activities that occur within or adjacent to native habitats, or when project review by the biologist deems it necessary the following measures will be implemented: • If vehicles and equipment used will arrive from off-base, these vehicles and equipment will be cleaned prior to use at the site to avoid importing seeds of non-native species onto the Base; • Erosion control measures and borrow materials used will be certified weed free to the extent possible; • Landscaping of project areas will use only species native to the western Mojave Desert to avoid the spread of non-native species on the base. • Herbicides must be applied in accordance with the Edwards AFB *Integrated Pest Management Plan (2016)*.

Table 2-3
Summary of Minimization Measures

Resource	Measures to Minimize or Reduce Impacts
Noise	**MM NOI-1:** Noise levels could be reduced by limiting construction noise to daytime (e.g., 7:00 a.m. to 7:00 p.m.) and shortening work periods. In addition, noise levels would be minimized by keeping the construction activities at a distance from residential areas, where possible and where necessary. Where noise may be a concern during construction, monitoring at the receptor location may be considered to minimize impact to sensitive receptors and communities. Noise levels would return to background levels once construction activities cease.
Socioeconomics	No minimization or mitigation measures would be required.
Water Resources	**MM HYD-1:** Selected projects in any of the planning districts may require a SWPPP in support of a NPDES permit in connection with construction activities. Implementation of a SWPPP would protect downstream water quality, as sediment erosion would be controlled and sediment movement from the proposed alternative during construction would be reduced. **MM HYD-2:** To reduce hazards from flooding, construction should be limited to areas outside 100-year flood zones. **MM HYD-3:** No construction or earthmoving should occur that would result in the modification of existing natural drainages; nor should it occur on a dry lake that is not dry.

3.0 AFFECTED ENVIRONMENT

This chapter describes existing environmental conditions likely to be affected by the Proposed Alternatives, including the No Action Alternative. It provides the baseline information for the installation that was used to identify and evaluate potential environmental changes resulting from the implementation of the Proposed Alternatives. Where appropriate, more specific information is provided by Planning District. Resources identified that may be affected by the project include air quality and greenhouse gases, cultural and paleontological resources, geology and soils, hazardous materials and hazardous waste, infrastructure, natural resources, noise, socioeconomics and water resources.

3.1 AIR QUALITY AND GREENHOUSE GASES

Edwards AFB is located within the Mojave Desert Air Basin (MDAB), which consists of portions of San Bernardino, Kern, and Los Angeles counties. The Main Base at Edwards AFB is located in the eastern portion of Kern County, but portions extend to Los Angeles County in the south and San Bernardino County in the east. Eastern Kern County is located on the western edge of the MDAB and is separated from populated valleys and coastal areas to the west and south by several mountain ranges. These valleys and coastal areas contain the major source of ozone precursor emissions affecting ozone exceedances within Kern County, Los Angeles County and San Bernardino County portions of the MDAB. The region is largely impacted by ozone transport from both the San Joaquin Valley Air Basin and the South Coast Air Basin. Elevated levels of particulate matter are primarily associated with fugitive dust, which is produced through a combination of high winds, dry soil conditions resulting from an arid climate, and ground-disturbing activities such as mining, agriculture, and construction.

Most activities associated with all alternatives would take place primarily within Kern County. The Kern County portion of Edwards AFB is under the jurisdiction of the Eastern Kern Air Pollution Control District (EKAPCD), while the Los Angeles County portion of Edwards AFB is under the jurisdiction of the Antelope Valley Air Quality Management District (AVAQMD) and the San Bernardino County portion of Edwards AFB is under the jurisdiction of the Mojave Desert Air Quality Management District (MDAQMD). These three districts constitute most of the MDAB.

3.1.1 Air Quality

Air quality in a given location is defined by the concentration of various pollutants in the atmosphere. By comparing a pollutant concentration in the atmosphere to Federal and/or State ambient air quality standards, the significance of its presence can be determined.

Pursuant to the Federal Clean Air Act Amendments of 1990 (CAA), the United States Environmental Protection Agency (USEPA) has established National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. The NAAQS are classified as primary and secondary standards. Primary standards prescribe the maximum permissible concentration of pollutants in the ambient air and are required to protect public health. Secondary standards specify the levels of air quality required to protect public welfare, including materials, soils, vegetation, and wildlife, from any known or anticipated adverse effects. NAAQS are established for six pollutants (known as criteria pollutants): ozone (O_3), particle pollution (i.e., respirable particulate matter less than 10 microns in diameter [PM_{10}] and respirable particulate matter less than 2.5 microns in diameter [$PM_{2.5}$]), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and lead (Pb). Under the federal CAA, attainment and maintenance of NAAQS are required.

The CARB has also adopted its own air quality standards in the state of California, known as the California Ambient Air Quality Standards (CAAQS) under the California CAA. The CAAQS are generally more stringent than the NAAQS and include air quality standards for all the criteria pollutants listed under NAAQS plus sulfates (SO_4), hydrogen sulfide (H_2S), vinyl chloride, and visibility-reducing particulate matter. Visibility-reducing particulate matter is defined by the State of California as suspended particulate matter with a complex mixture of tiny particles that consists of dry solid fragments, solid cores with liquid coatings, and small droplets of liquid. These particles vary greatly in shape, size and chemical composition, and can be made up of many different materials such as metals, soot, soil, dust and salt. The California CAA established California's air quality goals, planning mechanisms, regulatory strategies, and standards of progress aimed at meeting and/or exceeding CAA requirements for air quality. The California CAA requires attainment of CAAQS for criteria pollutants by the earliest practicable date. A summary of Federal and State ambient air quality standards is provided in Table 3-1.

Table 3-1
National and State Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards [1] Concentration [3]	National Standards [2] Primary [3,4]	National Standards [2] Secondary [3,5]
Ozone (O_3)[6]	1 Hour	0.09 ppm (180 µg/m^3)	—	Same as Primary Standard
	8 Hour	0.070 ppm (137 µg/m^3)	0.070 ppm (137 µg/m^3)	
Particulate Matter (PM_{10})[7]	24 Hour	50 µg/m^3	150 µg/m^3	Same as Primary Standard
	Annual Arithmetic Mean	20 µg/m^3	—	
Fine Particulate Matter ($PM_{2.5}$)[7]	24 Hour	—	35 µg/m^3	Same as Primary
	Annual Arithmetic Mean	12 µg/m^3	12.0 µg/m^3	15 µg/m^3
Carbon Monoxide (CO)	1 Hour	20 ppm (23 mg/m^3)	35 ppm (40 mg/m^3)	—
	8 Hour	9.0 ppm (10 mg/m^3)	9 ppm (10 mg/m^3)	—
Nitrogen Dioxide (NO_2)[8]	1 Hour	0.18 ppm (339 µg/m^3)	100 ppb (188 µg/m^3)	—
	Annual Arithmetic Mean	0.030 ppm (57 µg/m^3)	0.053 ppm (100 µg/m^3)	Same as Primary Standard
Sulfur Dioxide (SO_2)[9]	1 Hour	0.25 ppm (655 µg/m^3)	75 ppb (196 µg/m^3)	—
	3 Hour	—	—	0.5 ppm (1,300 µg/m^3)
	24 Hour	0.04 ppm (105 µg/m^3)	0.14 ppm (for certain areas)[8]	—
	Annual Arithmetic Mean	—	0.030 ppm (for certain areas)[8]	—
Lead[10,11]	30 Day Average	1.5 µg/m^3	—	—
	Calendar Quarter	—	1.5 µg/m^3 (for certain areas)[10]	Same as Primary Standard
	Rolling 3-Month Average	—	0.15 µg/m^3	
Visibility Reducing Particles[12]	8 Hour	See Footnote 12	No National Standards	
Sulfates	24 Hour	25 µg/m^3		
Hydrogen Sulfide	1 Hour	0.03 ppm (42 µg/m^3)		
Vinyl Chloride[10]	24 Hour	0.01 ppm (26 µg/m^3)		

Sources:

1. Table extracted from http://www.arb.ca.gov/research/aaqs/aaqs2.pdf on August 2016, with information created May 4, 2016 (California Air Resource Board, 2016).

Table 3-1 Notes:

1. California standards for ozone, carbon monoxide, sulfur dioxide (1 and 24 hour), nitrogen dioxide, and particulate matter (PM10, $PM_{2.5}$, and visibility reducing particles), are values that are not to be exceeded. All others are not to be equaled or exceeded.
2. National standards (other than ozone, particulate matter, and those based on annual arithmetic mean) are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest 8-hour concentration measured at each site in a year, averaged over three years, is equal to or less than the standard. For PM_{10}, the 24-hour standard is attained when the expected number of days per calendar year with a 24-hour average concentration above 150 micrograms per cubic meter ($\mu g/m^3$) is equal to or less than one. For $PM_{2.5}$, the 24-hour standard is attained when 98 percent of the daily concentrations, averaged over three years, are equal to or less than the standard.
3. Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25 degrees Celsius (°C) and a reference pressure of 760 torr. Most measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 torr; ppm in this table refers to parts per million (ppm) by volume, or micromoles of pollutant per mole of gas.
4. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health.
5. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.
6. On October 1, 2015, the national 8-hour ozone primary and secondary standards were lowered from 0.075 to 0.070 ppm.
7. On December 14, 2012, the national annual PM2.5 primary standard was lowered from 15 $\mu g /m^3$ to 12.0 $\mu g /m^3$. The existing national 24-hour $PM_{2.5}$ standards (primary and secondary) were retained at 35 $\mu g /m^3$, as was the annual secondary standard of 15 $\mu g /m^3$. The existing 24-hour PM10 standards (primary and secondary) of 150 $\mu g /m^3$ also were retained. The form of the annual primary and secondary standards is the annual mean, averaged over 3 years.
8. To attain the 1-hour national standard, the 3-year average of the annual 98th percentile of the 1-hour daily maximum concentrations at each site must not exceed 100 parts per billion (ppb). Note that the national 1-hour standard is in units of ppb. California standards are in units of ppm. To directly compare the national 1-hour standard to the California standards the units can be converted from ppb to ppm. In this case, the national standard of 100 ppb is identical to 0.100 ppm.
9. On June 2, 2010, a new 1-hour SO_2 standard was established and the existing 24-hour and annual primary standards were revoked. To attain the 1-hour national standard, the 3-year average of the annual 99th percentile of the 1-hour daily maximum concentrations at each site must not exceed 75 ppb. The 1971 SO_2 national standards (24-hour and annual) remain in effect until one year after an area is designated for the 2010 standard, except that in areas designated nonattainment for the 1971 standards, the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standards are approved. Note that the 1-hour national standard is in units of ppb. California standards are in units of ppm. To directly compare the 1-hour national standard to the California standard the units can be converted to ppm. In this case, the national standard of 75 ppb is identical to 0.075 ppm.
10. The CARB has identified lead and vinyl chloride as 'toxic air contaminants' with no threshold level of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.
11. The national standard for lead was revised on October 15, 2008 to a rolling 3-month average. The 1978 lead standard (1.5 j.tg/m3 as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978 standard, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.
12. In 1989, the ARB converted both the general statewide 10-mile visibility standard and the Lake Tahoe 30-mile visibility standard to instrumental equivalents, which are "extinction of 0.23 per kilometer" and "extinction of 0.07 per kilometer" for the statewide and Lake Tahoe Air Basin standards, respectively.

Existing Conditions

The USEPA classifies the air quality within an Air Quality Control Region with regard to its attainment of Federal primary and secondary NAAQS. Pursuant to USEPA guidelines, an area with air quality better than the NAAQS for a specific pollutant is designated as being in attainment for that pollutant. Any area not meeting the NAAQS is classified as a nonattainment area. Where there is a lack of data for the USEPA to make a determination regarding attainment

or nonattainment, the area is designated as unclassified and is treated as an attainment area until proven otherwise. Similarly, CARB makes state area designations for the state criteria pollutants.

Pollutant concentrations are assessed relative to both the Federal and State AAQS. To determine attainment of the NAAQS and CAAQS, air districts monitor air quality through a network of air monitoring stations within their boundaries. Data collected at the monitoring stations is compiled and used to track air quality conditions and support attainment efforts.

As of April 22, 2016, the USEPA listed the Federal attainment status of the Eastern Kern County, San Bernardino County, and Los Angeles County portions of the MDAB as summarized in

Table 3-2 (USEPA, 2016). The state attainment as recorded by CARB for these areas as of December 15, 2016 is also summarized in Table 3-2(CARB, 2015).

Table 3-2
Federal and State Attainment Status

Pollutant	**Area within the MDAB**		
	Eastern Kern APCD [1]Federal ([2]State)	**Los Angeles Portion of AVAQMD [1]Federal ([2]State)**	**San Bernardino Portion of MDAQMD [1]Federal ([2]State)**
O3	Nonattainment (Nonattainment)	Nonattainment (Nonattainment)	Nonattainment (Nonattainment)
PM2.5	Unclassified/Attainment (Unclassified)	Unclassified/Attainment (Unclassified)	Unclassified/Attainment (Nonattainment)
PM10	Unclassified (Nonattainment)	Unclassified (Nonattainment)	Nonattainment (Nonattainment)
CO	Unclassified/Attainment (Unclassified)	Unclassified/Attainment (Attainment)	Unclassified/Attainment (Attainment)
NO2	Unclassified/Attainment (Attainment)	Unclassified/Attainment (Attainment)	Unclassified/Attainment (Attainment)
SO2	Unclassified	Unclassified	Unclassified
Pb	Unclassified/Attainment (Attainment)	Unclassified/Attainment (Attainment)	Unclassified/Attainment (Attainment)

Source: **1** USEPA, 2016
2 CARB, 2015

Notes: O_3 ozone
$PM_{2.5}$ particulate matter less than 2.5 microns in diameter
PM_{10} particulate matter less than 10 microns in diameter
CO Carbon monoxide
NO_2 nitrogen dioxide
SO2 sulfur dioxide
Pb lead

General Conformity Requirements

Section 176(c) of the Federal CAA contains requirements that apply specifically to Federal agency actions, including actions receiving Federal funding. This section of the CAA requires Federal agencies to ensure that their actions are consistent with the CAA and with applicable state air quality management plans. The general conformity regulation is codified in 40 CFR, Part 51, Subpart W, and Part 93, Subpart B.

Federal agencies are required to evaluate their proposed actions to ensure that they will not cause or contribute to new violations of any Federal ambient air quality standards, that they will not increase the frequency or severity of any existing violations of Federal ambient air quality standards, and that they will not delay the timely attainment of Federal ambient air quality standards. To this end, the USEPA general conformity rule requires a formal conformity determination document for Federally sponsored or funded actions in nonattainment or maintenance areas when the net increase in direct and indirect emissions of nonattainment or maintenance pollutants exceeds specified *de minimis* thresholds.

A Federal action is exempt from general conformity requirements if the total emissions resulting from the action are equal to or less than the *de minimis* thresholds. Thus, the action's calculated emissions are compared to established *de minimis* emission levels based on the nonattainment status for each applicable criteria pollutant in the area of concern to determine the relevant compliance requirements. Table 3-3 defines the *de minimis* thresholds that apply to Kern, Los Angeles, and San Bernardino counties. If the calculated emissions are equal to or greater than *de minimis* levels, then the requirements of air conformity apply to the action.

Table 3-3
De Minimis Thresholds in Federal Nonattainment Areas

Pollutant	Degree of Non-attainment	*De Minimis* Level (tons/year)	Kern County	Los Angeles County	San Bernardino County
O_3	Serious	50			
	Severe	25		X	X
	Extreme	10			
	Marginal and Moderate (outside an ozone transport region)	100	X		
	Marginal and Moderate (inside an ozone transport region)	50 (VOC)			
		100 (NO_x)			
CO	All	100			
PM_{10}	Moderate	100			X
	Serious	70			
SO_2 or NO_2	All	100			
Pb	All	25			

Notes: O_3 ozone
$PM_{2.5}$ particulate matter less than 2.5 microns in diameter
CO Carbon monoxide
NO_2 nitrogen dioxide
SO2 sulfur dioxide
Pb lead

3.1.2 Greenhouse Gases (GHG)

Background

Changes in global climate patterns have recently been associated with global warming, an average increase in the temperature of the atmosphere near the Earth's surface, attributed to accumulation of GHG emissions in the atmosphere. Climate change refers to any significant change in measures of climate, such as average temperature, precipitation, or wind patterns over a period of time. GHGs trap solar heat in the atmosphere, which in turn heats the surface of the earth. Some GHGs occur naturally and are emitted to the atmosphere through natural processes, while others are created and emitted solely through human activities (e.g., combustion of fossil fuel). Common GHGs include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). GHGs are commonly quantified in the equivalent mass of CO_2, denoted as carbon dioxide equivalent (CO_2e), which takes into account the global warming potential (GWP)

of each individual GHG compound. The most common GHG that results from human activity is CO_2, followed by CH_4 and N_2O.

CO_2 enters the atmosphere through burning fossil fuels (coal, natural gas and oil), solid waste, trees and wood products, and also as a result of certain chemical reactions (e.g., manufacture of cement). CO_2 is removed from the atmosphere (or "sequestered") when it is absorbed by plants as part of the biological carbon cycle.

CH_4 is emitted during the production and transport of coal, natural gas, and oil. CH_4 emissions also result from livestock and other agricultural practices and by the decay of organic waste in municipal solid waste landfills.

N_2O is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste.

HFCs, PFCs, and SF_6 are synthetic, powerful GHG that are emitted from a variety of industrial processes. Fluorinated gases are sometimes used as substitutes for stratospheric ozone-depleting substances (e.g., chlorofluorocarbons, hydrochlorofluorocarbons, and halons).

Federal GHG. The following paragraphs describe some approaches taken by Federal agencies to address climate change.

Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, issued in October of 2009, states that Federal agencies must increase energy efficiency, measure, report and reduce their GHG emissions from direct and indirect activities.

Executive Order 13653, *Preparing the United States for the Impacts of Climate Change*, was signed in November 2013 provides direction for Federal agencies to facilitate efforts for American communities to strengthen their resilience to climate change.

The USEPA is the agency responsible for writing and implementing Federal regulation for the protection of the environment, including implementation of measures to address climate change. To this end, the USEPA pursues a number of efforts, including regulatory initiatives such as the

GHG Reporting Program, standards for new motor vehicles, Renewable Fuel Standard Program, and landfill air pollution standards (USEPA, 2014).

The GHG Reporting Program (i.e., 40 CFR, Part 98) requires mandatory reporting of GHG emissions for certain industrial operations, most of which are large emitters of GHGs (e.g., electricity generation facilities, oil refineries, and manufacturing operations). Mandatory reporting is also required for facilities capable of emitting more than 25,000 metric tons of CO_2e ($MTCO_2e$) per year from all combined stationary fuel combustion sources (e.g., boilers and stationary engines).

California GHG. California pursuit of GHG emission reductions is primarily based on Executive Order S-3-05, Assembly Bill (AB) 32, and CCR sections 95100-95157. The following paragraphs describe some approaches taken by California agencies to address climate change.

On June 2005, Executive Order (EO) S-3-05 was issued to set GHG goals. EO S-3-05 prescribes a goal to reduce GHG emissions by 80 percent below 1990 levels by 2050 (California ARB 2014a).

On 27 September 2006, Governor Arnold Schwarzenegger signed into law Assembly Bill 32 (AB 32), California Global Warming Solutions Act of 2006, which requires the ARB to develop and implement regulations and initiatives to reduce GHG emissions to 1990 levels, or lower, by 2020. The ARB established the 1990 target at 427 MMT CO2e. Pursuant to AB 32 the ARB has also adopted a number of regulations, which are outlined in the initial Scoping Plan, which the ARB adopted in 2008 to prescribe actions aimed at reducing California’s GHG emissions. Under AB 32, the ARB has primary responsibility for promulgating regulations, programs, and enforcement mechanisms to achieve the GHG reduction target.

The law requires the ARB to establish a program geared towards tracking and reporting GHG emissions; approve a scoping plan for achieving the maximum technologically feasible and cost effective reductions from sources of GHG emissions; adopt early reduction measures to begin moving forward; and adopt, implement and enforce regulations – including market mechanisms such as “cap-and-trade” programs – to ensure the required reductions occur. The ARB recently

adopted a statewide GHG emissions limit and an emissions inventory, along with requirements to measure, track, and report GHG emissions by the industries it determined to be significant sources of GHG emissions.

AB 32 requires ARB to update the Scoping Plan every five years. The most recent update to the Scoping Plan Update was approved by the ARB in May 2014. It identifies opportunities to leverage existing and new funds to further drive GHG emission reductions through strategic planning and targeted low carbon investments. The Update defines ARB's climate change priorities for the next five years and sets the groundwork to reach California's long-term climate goals set forth in EOs S-3-05 and B-16-2012. The Update highlights California's progress toward meeting the near-term 2020 GHG emission reduction goals defined in the initial Scoping Plan. These efforts put California on course to achieve the near-term 2020 goal, and have created a framework for ongoing climate action that can be built upon to maintain and continue economic sector-specific reductions beyond 2020, as required by AB 32. In this Update, nine key focus areas were identified (energy, transportation, agriculture, water, waste management, and natural and working lands), along with short-lived climate pollutants, green buildings, and the Cap-and-Trade Program.

On December 2007, California adopted regulation for the mandatory reporting of GHG emissions (mandatory reporting regulation [MRR]) under California Code of Regulations (CCR) sections 95100-95157 to comply with requirements promulgated by the U. S. EPA in 40 Code of Federal Regulations (CFR), Part 98. The MRR sets emissions reporting thresholds of 10,000 MTCO2e. Thus, any project or facility with the potential to emit equal to or greater than 10,000 MTCO2e from combustion and process emissions would be subject to the MRR reporting requirements.

On March 2012 EO B-16-2012 was issued to support the reduction of GHGs through zero-emission vehicles as a measure to pursue achievement of California target for 2050 to reduce GHG emissions from the transportation sector equaling 80 percent less than 1990 levels.

On April 2015 EO B-20-15 establishes a mid-term GHG goal for California to reduce GHG emissions by 40 percent below 1990 levels by 2030. EO B-20-15 requires agencies to

implement measures designed to achieve the goal prescribed in EO B-20-15. EO B-20-15 also prompted an update of AB 32 Scoping Plan.

Existing Conditions

Based on the 2014 update of the California GHG inventory for 2000 to 2012 prepared by the CARB, California emitted 458.68 million metric tons (MMT) CO_2e in 2012 (CARB, 2014b). According to CARB, the potential impacts in California due to global climate change may include loss in snow pack; sea level rise; more extreme heat days per year; more high ozone days; more large forest fires; more drought years; increased erosion of California's coastlines; sea water intrusion into the Sacramento and San Joaquin Deltas and associated levee systems; and increased pest infestation. As previously mentioned, various measures are currently in effect to reduce GHG emissions in an effort to mitigate climate change effects resulting from anthropogenic activity.

3.2 CULTURAL AND PALEONTOLOGICAL RESOURCES

The following section provides the contextual background information for known cultural and paleontological resources identified at Edwards AFB, including paleontological, prehistoric, ethnographic, and historical settings. This section also summarizes the results of previous cultural resource surveys (for both archaeological and architectural resources) within each of the Planning Districts.

3.2.1 Overview

The information provided herein is based primarily on previous cultural resources studies (Boyer, 2005; Bupp et al., 1998; Crosby, 2010; Earle et al., 1997; Earle et al., 1998; ECORP Consulting, Inc., 2013; Edwards AFB, 2012a; Giambastiani et al., 2007; Giambastiani et al., 2013; Green et al., 2002; Hale and Hanten 2014; Hector et al., 1988; Holmes et al., 2004; Jones and Stokes, 1998; King and Spinney, 2010; King et al., 2010; Macko, 1993; McGetrick et al., 2002; Parker, 2001; Puckett et al., 2003; Puckett and Peyton, 2008; Puckett and Spinney, 2004, 2005; Ronning et al., 1997; Spinney and Mates, 2010; Spinney, 2004; Sutton and Robinson, 1977; and Wade and Hector, 1989). Over the last 37 years, cultural resources studies were conducted in compliance with the NEPA, the National Historic Preservation Act (NHPA, of

1966, as amended; see 16 USC 470f), and the California Environmental Quality Act (CEQA) to identify archaeological, historical built architectural resources, and other cultural resources on Edwards AFB and provide a baseline for the types of archaeological sites that may be identified within each of the Planning Districts. [Due to the confidential nature of certain types of cultural resources information, the locations of archaeological resources have been removed from these reports].

In accordance with the NHPA and NEPA, the USAF will perform consultation with the Federally-recognized Native American Tribes and tribal representatives identified in the Edwards AFB *Integrated Cultural Resources Management Plan* (ICRMP) (Edwards AFB, 2017).

Also in accordance with NEPA, a paleontological resources records search will be conducted through the Natural History Museum of Los Angeles County (NHM). The potential for paleontological resources to be affected by the proposed project is discussed within this section.

This section presents a brief overview of the environmental setting and cultural history for the proposed project location. Understanding the environmental setting of a project area aids in identifying the types of resources that may be encountered during the proposed project, or that would be associated with a certain type of land use. As a result, the context relies heavily upon previous research, with an emphasis on historical information that has been gleaned from archaeological survey reports prepared for Edwards AFB between the 1980s and present. Additional information pertaining to the environmental setting of the Antelope Valley and Mojave Desert may be found in the Edwards AFB ICRMP (Edwards AFB, 2017) and the Edwards AFB cultural overviews (Earle et al., 1997; Earle et al., 1998; Ronning et al., 1997). Likewise, concise reports prepared for architectural resources have been incorporated into the ICRMP and cultural overviews.

Edwards AFB is situated within the Antelope Valley which is in the Western Mojave Desert. The Mojave Desert is characterized by a region of isolated mountain ranges, separated by desert plains; it is wedged between the Garlock Fault and the San Andreas Fault, which have uplifted the surrounding mountains relatively rapidly. This uplift resulted in an isolation of the Mojave

Desert from the Pacific Coast, creating the interior drainage basins of the Western Mojave Desert, such as the Antelope Valley. On the west end, the Antelope Valley is defined by the Tehachapi and San Gabriel mountains, which form a "v"-shaped basin along the western boundary of the Mojave Desert.

The Antelope Valley floor is comprised of thick deposits of Quaternary alluvial and lacustral (lakebed) sediments. The alluvial sediments are subdivided into two units: the older or Pleistocene Quaternary sediments, and the younger or Holocene alluvial surface deposits, both of which derive from nearby granitic mountains and have been deposited on the valley floor over thousands of years. These sediments include loosely consolidated mixtures of gravel, sand, and clay and extend to depths of 10 feet or greater beneath the surface.

Paleoenvironment and Paleontological Setting

Between 12,000 and 10,000 years ago, the western United States faced environmental change on a mass scale; the glaciers began to recede; the climate dramatically became warmer and drier; and vegetation and animals began inhabiting higher elevations (Earle et al., 1997; ECORP Consulting Inc., 2013; Sutton and Robinson, 1997).

Based on paleontological evidence, by the late Pleistocene age, the Antelope Valley was inhabited by numerous large mammalian species (e.g., sloths, horses, bears, mammoth, bison, camels, as well as prong-horned antelope), large carnivorous species (e.g., saber-toothed cats, wolves, mountain lions, desert coyotes and foxes), smaller animals (e.g., rabbits, squirrels, and other rodents), and a multitude of birds. The evidence also reveals that desert vegetation began replacing the low-elevation woodlands as early as 12,000 and 8,000 years ago and the types of plants and animal communities present in the Antelope Valley today were not established until 4,300 years ago. Around that time, modern researchers have identified evidence of a large, fresh-water lake, Lake Thompson, which covered much of the Antelope Valley. Approximately 8,000 years ago, Lake Thompson receded, splitting into Rosamond, Buckhorn, and Rogers lakes (Earle et al., 1997; ECORP Consulting Inc., 2013; Giambastiani et al., 2007; Giambastiani et al., 2013; Sutton and Robinson, 1997).

Paleontological resources are the mineralized (fossilized) remains of prehistoric plants and animals and the mineralized impressions (trace fossils) left as indirect evidence of the forma and activity of such organisms. These resources are located within sedimentary rocks or alluvium and are considered nonrenewable.

Formations that contain vertebrate fossils are considered more sensitive because vertebrate fossils tend to be rare and fragmentary. Formations containing microfossils, plant casts, and invertebrate fossils are more common. A significant fossil deposit is a rock unit or formation that contains significant nonrenewable paleontological resources. This is defined as comprising one or more identifiable vertebrate fossils, large or small, and any associated invertebrate and plant fossils, traces, and other data that provide taphonomic, taxonomic, phylogenetic, ecologic, and stratigraphic information (ichnites and trace fossils generated by vertebrate animals such as trackways or nests or middens), which provide datable material and climatic information. This definition excludes invertebrate or botanical fossils except when present within a given vertebrate assemblage. However, invertebrate and botanical fossils may be significant as environmental indicators associated with vertebrate fossils.

Prehistoric Setting

Since the 1980s, new archaeological research, relying upon radiocarbon dating, obsidian hydration, and flaked stone technology profiles, has refined the prehistoric chronology of human occupation in the Mojave Desert, which suggests cultural resources dating to the Pleistocene, early Holocene, middle Holocene, and the late Holocene. Additionally, it has been theorized that a Pre-Clovis complex, pre-dating 12,000 years before present (BP), occupied portions of the Mojave Desert, although little to no solid archaeological evidence has been documented (Bupp et al., 1998; Earle et al., 1997; ECORP Consulting Inc., 2013; Giambastiani et al., 2007; Giambastiani et al., 2013; Holmes et al., 2004; Macko, 1993; and Sutton and Robinson, 1997). The chronology has been subdivided into the following:

- The Fluted Point or Late Pleistocene Period (12,000 to 10,000 BP)
- Lake Mojave Period or Early Holocene (10,000 to 7,000 BP)
- The Pinto Period or the Early to Middle Holocene (7,000 to 4,000 BP)
- Gypsum Period (4,000 to 1450 BP)

- Saratoga Spring/Rose Spring Period or the Late Holocene (1450 to 750 BP) and
- Late Prehistoric Period or Late Holocene (950 BP to Contact, circa 180 BP)

Ethnographic Setting

Ethnographic accounts indicate that the project area was used by two groups, the Kitanemuk and the Kawaiisu, each of which is briefly described in the following paragraphs.

The Kawaiisu occupied the Piute Mountains at the southern end of the Sierra Nevada Range and the northern part of the Tehachapi Mountains, as well as portions of the valley floors. Kawaiisu economy was based on hunting and gathering, with their primary food sources including acorns, deer, bighorn sheep, rabbits, and pronghorn.

The Kitanemuk occupied the territory extending from the Tehachapi Mountains into the western end of the Antelope Valley. During cooler seasons or at least seasonally, it is believed they migrated into the arid valley floors; during the Late Prehistoric Period, the settlements became permanent along the desert floor. By the Mission Period (1769 to 1834), the Kitanemuk were moved to the missions of San Fernando, San Gabriel, and San Buenaventura. By the 1850s, some Kitanemuk settled at Fort Tejon and nearby Tejon Ranch, but were moved later onto the Tule Reservation.

Historic Context

Among the earliest non-native populations to occupy the area were Spanish explorers, who arrived in the Antelope Valley in the 1770s. By 1828, both Mexican traders and American trappers led by Jedediah Smith established two routes through the area providing access from the Mojave Desert to the coast, via the Old Spanish Trail near the Cajon Pass, and the Owens Valley Road through the Tehachapi Pass. The routes were used later by Kit Carson and John C. Fremont (1844), and later by survey parties searching for an alternative route for the transcontinental railroad; it would not be until 1876 that the Southern Pacific Railroad extended through the Antelope Valley and until 1884 that the Atchison, Topeka & Santa Fe traversed through Mojave. By the mid-1860s and 1870s, the Antelope Valley was used extensively as an access route between Los Angeles and mining districts to the east, including mines in the Rosamond area.

Colonization companies representing Quakers, German Lutherans, Scots, English, and others began to promote settlement of the southern Antelope Valley by the 1880s. Between 1880 and the early 1920s, farms in the Antelope Valley flourished, producing wheat, barley, grains, alfalfa, fruits and nuts, along with cattle and sheep rearing, with the one mile-square townsite of Lancaster being established between 1883 and 1884. Rural areas outside of Lancaster, including much of Edwards AFB, were settled by families who purchased lands from the Federal government, railroad, or obtained land patents. Between 1910 and the mid-1930s, hundreds of claims were filed for land within the Edwards AFB boundaries and the Antelope Valley. However, by the 1930s intermittent droughts, flooding, extreme winds, high temperatures and the Dust Bowl – a worldwide economic depression – resulted in the failure of utopian colonies and homesteads, with many residents leaving the area and a decrease in the number of homestead claims being filed (Edwards AFB, 2012b; Earle et al., 1998; Puckett and Spinney 2004, 2005; Puckett et al., 2003; Puckett and Peyton, 2008; Spinney 2004).

With the onset of World War II, the Antelope Valley saw economic growth due to the arrival of the military. Initial construction efforts for the military training area included a tent camp and several adjacent areas for both weapon and aircraft training at the northeast edge of Rogers Dry Lakebed. The War Department authorized construction of the Army Air Base at Muroc Lake (the precursor to present-day Edwards AFB), which would play a strategic role in World War II, serving as the primary installation providing long-range air patrols from the Pacific Coast and training air crews for combat. Much of the construction associated with the Army Air Base took place adjacent to the Muroc town site, on the west edge of Rogers Dry Lakebed at South Base, while a series of hangars were added shortly thereafter at what would become North Base.

Between 1950 and the 1960s, the population of Lancaster jumped from 3,600 to 29,000. Increased development included the enlargement of the South Base and formation of today's Main Base. The 1980s and 1990s saw increased development with NASA, as the first space shuttle orbiter was assembled at an aerospace plant in Palmdale and transported to Edwards AFB. Today the installation serves as a flight test center for testing new aircraft and weaponry, along with an area which provides a suitable environment for testing propulsion systems and vehicles for space exploration.

3.2.2 Cultural Resources within Each Planning District

Based on past land use activities in the Regional Area, prior cultural resources studies, and the ICRMP, the types of cultural resources that may be present in the Planning Districts include the following:

- ***Prehistoric Archaeological Sites:*** to include archaeological sites encompassing base camps or villages, lithic deposits, roasting pits or hearths, and temporary camp sites
- ***Historic-Period Archaeological Sites:*** to include archaeological sites such as agricultural features, homesites, refuse deposits, mining features, railroads, or labor camps
- ***Sub-Modern Archaeological Sites:*** to include archaeological sites that date between 45 and 50 years of age
- ***Multi-Component Archaeological Sites:*** to include archaeological sites containing both prehistoric and historic-period or sub-modern artifacts or features
- ***Built-Environment/Structures:*** to include standing structures, buildings, or objects that are not in ruinous condition (otherwise considered archaeological remains)
- ***Isolated Finds:*** to include one or two individual artifacts with no other associated cultural material. Isolated finds may include prehistoric, historic period, or sub-modern artifacts

Previous archaeological surveys identified 4,657 archaeological sites throughout Edwards AFB; of these, 3,439 are considered eligible for the NRHP or not yet evaluated. There are 11 sacred sites identified by Native American Tribes. To date, 66% of Edwards AFB has been surveyed for archaeological resources. Of the 3,234 facilities and structures listed in Edwards AFB Real Property (included in the Automated Civil Engineering System) that are tracked by Cultural Resources, 368 have been evaluated and concurred upon. One (1) has been determined Individually Listed National Historic Landmark (NHLI), 12 have been determined Individually Eligible for the NRHP and NREI, 139 have been determined Contributing to a District Eligible for the NRHP (NREC) and 216 have been Determined Not Eligible (DNE).

The majority of the Planning Districts have been surveyed for cultural resources (both archeological and architectural resources) previously, with multiple archaeological resources being identified within each of the proposed Planning Districts.

3.2.3 Paleontological Resources

The Antiquities Act of 1906 and the Department of Interior's Preservation of American Antiquities (43 CFR 3) extend protection to paleontological resources. While no formal surveys have been performed to specifically identify paleontological localities on Edwards AFB, many paleontological resources have been identified and recorded in conjunction with cultural resources studies on the installation. As a result, a total of 776 localities have been identified on Edwards AFB to include fossilized nonhuman vertebrate and plant specimens. Individual paleontological remains not identified in association to an archaeological site are documented using paleontological locality forms, which are submitted to the State Historic Preservation Office. There have been no mitigation measures undertaken for paleontological resources on Edwards AFB; the same procedures employed for archaeological resources are applied to the mitigation of paleontological resources on the installation.

3.3 GEOLOGY AND SOILS

The following section provides overview information for the topography, geology, seismicity and soils of Edwards AFB, and some more information for each planning district.

3.3.1 Overview

This section provides an overview of the topography, geology, seismicity, and soil at Edwards AFB.

Topography

Edwards AFB is located approximately five miles northeast of the City of Lancaster in the Antelope Valley of Southern California, and includes portions of three different counties (Kern, Los Angeles, and San Bernardino) encompassing approximately 480 square miles of the western Mojave Desert. Edwards AFB is located in a region of arid climate characterized by distinct summers and winters with short transition periods in between. Summers are hot and dry, and winters are mild and windy. The relatively high altitude and dry atmosphere allow for a large variance in daily temperatures. On average, there are 279 sunny days per year in the region. July, the warmest month, has an average high temperature of 99 degrees Fahrenheit while December, the coldest month, has an average low of 30 degrees Fahrenheit. Precipitation is

primarily in the form of rain that averages 5 inches annually and mostly falls between November and March. Typical basin and range topography observed in southwestern deserts is found at Edwards AFB (Edwards Air Force Base, 2012a). These features include mountain ranges and hill systems, alluvial fans, valley floors and basins. Rocky, gravelly and sandy washes are found throughout the installation. Antelope Valley is a closed topographic basin characterized by an interior drainage where infrequent storm water flow to Rogers Dry Lake, Buckhorn Dry Lake and Rosamond Dry Lake. Elevations at Edwards AFB range from 2,267 feet above mean sea level (AMSL) at Rogers Dry Lake to 3,424 feet (AMSL) at Red Buttes located on the installation’s eastern boundary.

Geology

Edwards AFB lies in the western portion of the Mojave Desert physiographic province which includes tertiary volcanic rocks and Quaternary alluvial sediments that overlie a basement complex consisting primarily of granitic intrusive rocks. Most of Edwards AFB is underlain by basement rock consisting primarily of quartz monzonite, an intrusive igneous rock similar to granite. Small, isolated exposures of carbonate rocks and volcanic tuff and basalt occur in the Bissel Hills found in the northwestern portion of the installation. Quaternary sediment deposits include older alluvium that is presumably of Pleistocene age, younger Holocene age, lacustrine sediments, and Holocene silt and sand deposits by wind and wave. Older alluvium consists of conglomerate, gravel, sand, silt and clay in thicknesses up to 1,000 feet. It covers much of Edwards AFB, forming portions of alluvial fans that extend from the rock outcrops on the hills down to the basins. Lacustrine (lake-related) sediments are sand, silt and clay that occupy both the present-day lakebeds, such as Rogers Dry Lake. Eolian (wind-related) sediments cover sizeable areas extending mainly from south and southwest of Rosamond Dry Lake east, past Rogers Dry Lake up the broad west slopes of the hills east of Rogers Dry Lake as well as scattered in smaller areas.

Seismicity

Southern California where Edwards AFB is located is seismically active. The San Andreas Fault Zone is located approximately 12 miles southwest of the southwestern corner of Edwards AFB, and the Garlock Fault Zone is approximately 12 miles to the northwest of the northwestern

corner. The Garlock Fault Zone trends southwest-northeast and meets the San Andreas Fault which trends northwest-southeast 45 miles west of the installation. During the last 20 years, major earthquakes recorded near Edwards AFB at greater than 5.0 on the Richter Magnitude Scale include the Landers and Big Bear earthquakes in June 1992 and the Mojave earthquake in July 1992 (United States Geological Survey 2009).

Other major faults mapped at Edwards AFB are depicted on Figure 3-1. These faults are generally parallel, northwest-southeast trending normal faults that produce horst and graben features. Alluvial deposits generally conceal the surface traces of these faults. Although there are no large active fault zones on the installation, the relative motion of the San Andreas and Garlock fault zones are responsible for the formation of a series of minor faults in the Mojave Desert including the six fault zones on the installation (Figure 3-1).

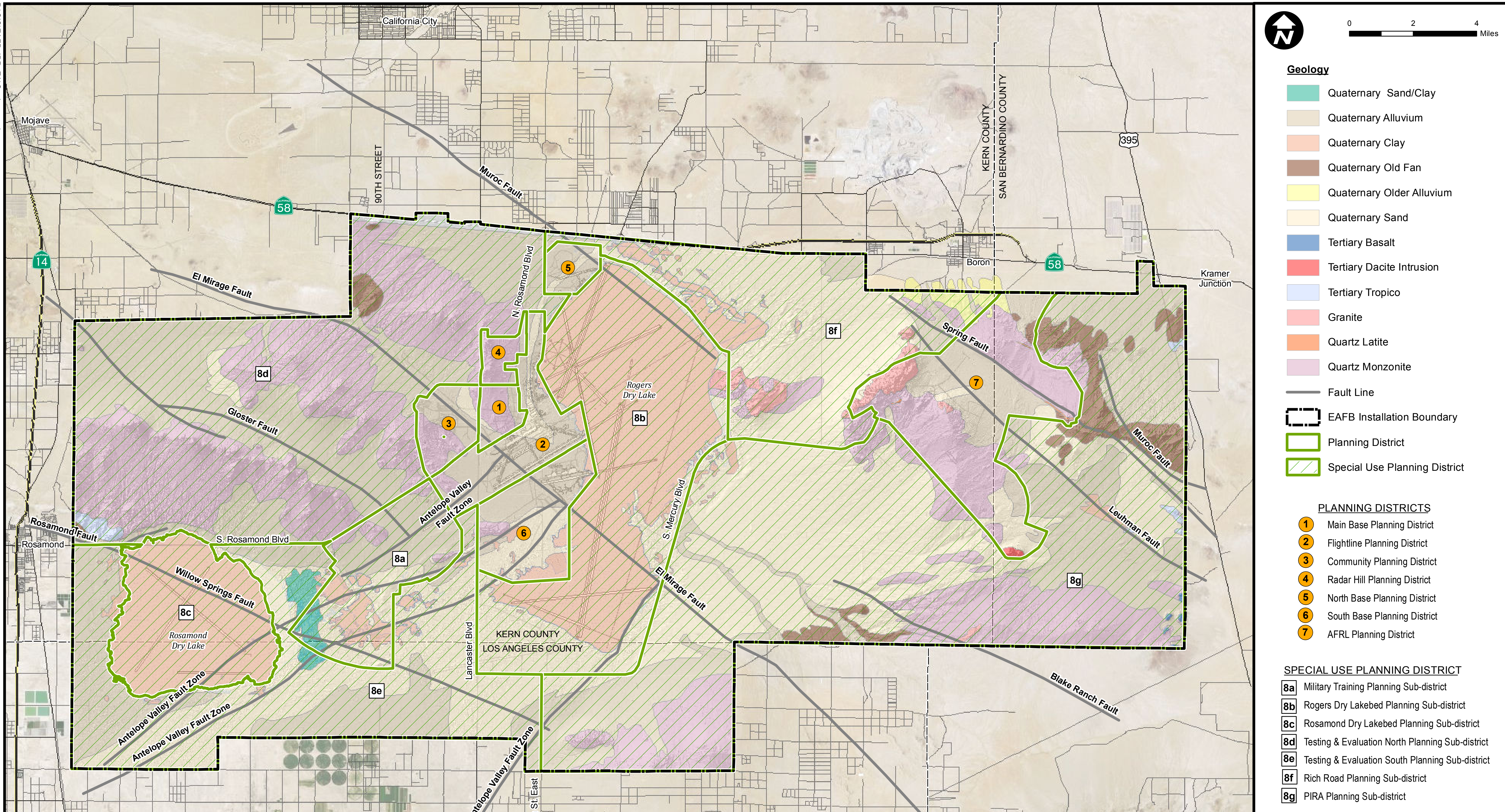
There are no Alquist Priolo Earthquake Fault zones within five miles of Edwards AFB. These zones are areas identified as having surface traces of active faults that have a potential for future surface fault rupture. Local agencies regulate development projects within these zones.

A delineation of seismic hazards was completed in 2005 for the Rosamond USGS 7.5-minute quadrangle which includes western-most portion of Edwards AFB (Department of Conservation, California Geologic Survey, 2005). This area is associated with the southern end of Rosamond Dry Lake and trending south with Division Street toward Lancaster. The seismic hazards report concluded that there are areas in the Rosamond 7.5-minute quadrangle that includes a minor portion of Edwards AFB where historical occurrence of liquefaction or local geological, geotechnical and groundwater conditions that indicate a potential for permanent groundwater displacements can occur.

Soils

A basewide survey of soils at Edwards AFB has been completed by the Natural Resources Conservation Service (NRCS) (Figure 3-2) (Edwards Air Force Base, 2012b). Most of the soils at Edwards AFB are sandy loams and loamy sands. Some of the soils have a silt or clay component, especially those associated with the dry lake beds. Many of the soils have been classified to a series level where only one taxonomic unit describes the soil. Others have been

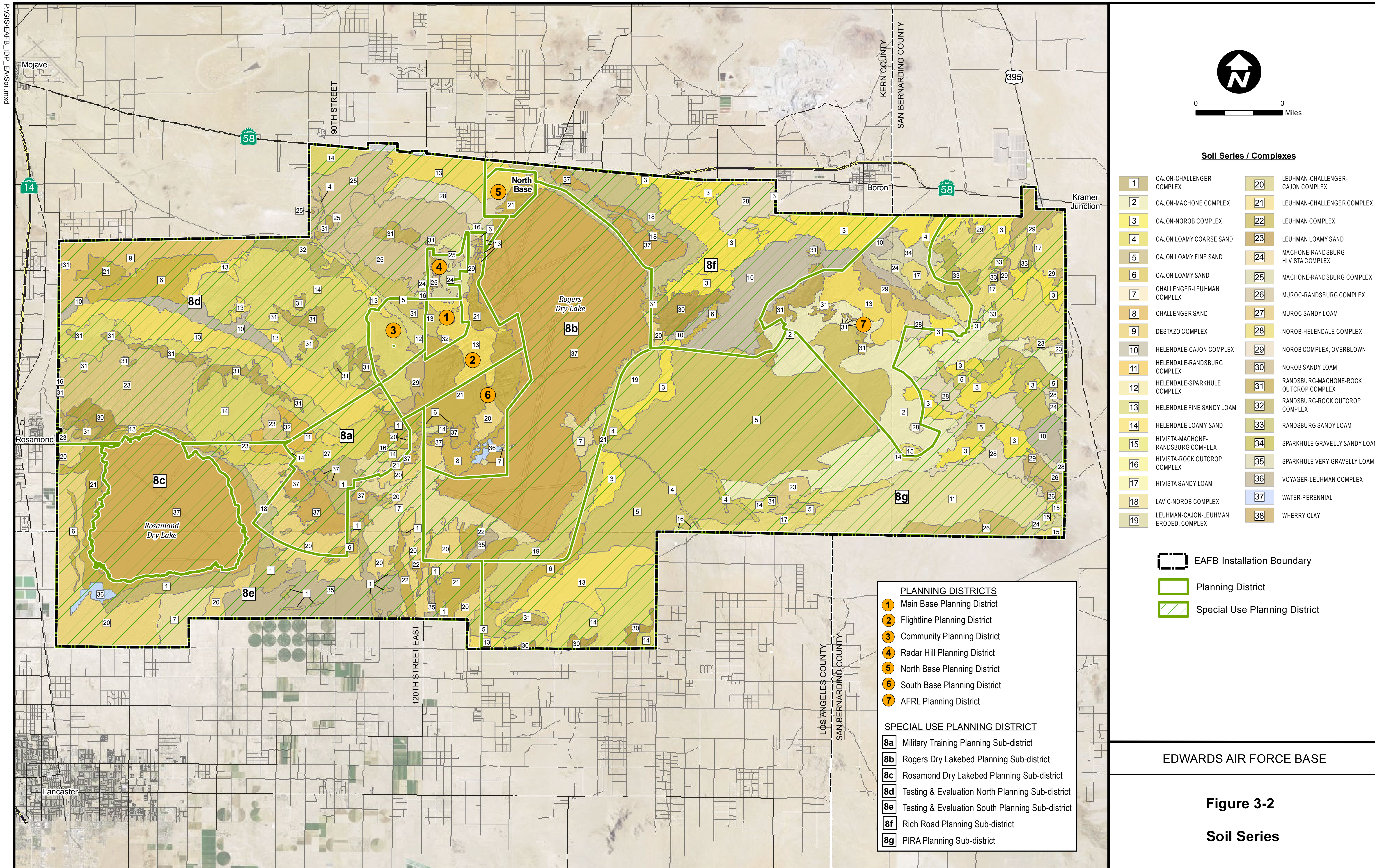
classified as complexes where two or more taxonomic units have been used to describe the soil (Figure 3-2). A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. In general, most of the soils found at Edwards AFB are deep soils, but some are developed on granitic bedrock that lie less than five feet below the ground surface. Nearly all of the soils found at Edwards AFB are moderately or highly susceptible to erosion by wind or stormwater flow if they are disturbed by construction or vehicle traffic. Soils become more easily eroded by wind or water when the surface if disturbed. The potential for wind erosion of soils at Edwards AFB can occur more frequently than water erosion. However, a major flood event can cause as much erosion as can occur from wind erosion (Edwards Air Force Base, 2012b).



EDWARDS AIR FORCE BASE

Figure 3-1

Geology



EDWARDS AIR FORCE BASE

Figure 3-2

Soil Series

3.3.2 Geology and Soils within each Planning District

Main Base Planning District

There are no known active faults underlying the Main Base Planning District. The primary faults present on Edwards AFB have been recognized as not being active (Edwards Air Force Base 1994). As a result of the low level of seismicity from these faults, most of the seismic activity in this area is ground shaking from activity along the San Andreas and Garlock faults. Soils associated with the Main Base Planning District are primarily sandy in texture and are potentially subject to wind and water erosion.

Flightline Planning District

There are no known active faults underlying the Flightline Planning District. The primary seismic hazard in this area is ground shaking from activity along the San Andreas and Garlock faults. Soils associated within this district are primarily sandy in texture and are potentially subject to wind and water.

Community Planning District

While the inactive El Mirage fault is found trending from the northwest to the southeast through this district, there are no known active faults underlying the Community Planning District. The primary seismic hazard in this area is ground shaking from activity along the San Andreas and Garlock faults. Soils associated with the Community Planning District are primarily sandy in texture and are potentially subject to wind and water erosion.

Radar Hill Planning District

There are no known active faults underlying the Radar Hill Planning District. The primary seismic hazard in this area is ground shaking from activity along the San Andreas and Garlock faults. Soils associated with the Radar Hill Planning District are primarily sandy in texture and are potentially subject to wind and water erosion.

North Base Planning District

There are no known active faults associated with the North Base Planning District. The primary seismic hazard in this area is ground shaking from activity along the San Andreas and Garlock

faults. The primarily sandy textured soils associated are potentially subject to wind and water erosion.

South Base Planning District

While the inactive El Mirage fault and Antelope Valley Fault Zone are found trending through this district, there are no known active faults underlying the South Base Planning District. The primary seismic hazard in this area is ground shaking from activity along the San Andreas and Garlock faults. Soils associated with the South Base Planning District are primarily sandy in texture and are potentially subject to wind and water erosion.

AFRL Planning District

While the inactive Spring Fault and Leuhman Fault are found trending through this district, there are no known active faults associated with the AFRL Planning District. The primary seismic hazard in this area is ground shaking from activity along the San Andreas and Garlock faults. Soils associated with the AFRL Planning District are primarily sandy in texture and are potentially subject to wind and water erosion.

Special Use Planning District

While there are inactive faults found trending through this district, there are no known active faults associated with the Special Use Planning District. The primary seismic hazard in this area is ground shaking from activity along the San Andreas and Garlock faults. Soils underlying the Special Use Planning District are primarily sandy in texture and are potentially subject to wind and water erosion.

3.4 HAZARDOUS MATERIALS AND HAZARDOUS WASTE

For purposes of this study, the terms “hazardous material” and “hazardous waste” are those substances defined by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Resource Conservation and Recovery Act (RCRA). A hazardous material is any material whose physical, chemical or biological characteristics, quantity, or concentration may cause or contribute to adverse effects in organisms or their offspring; pose a substantial present or future danger to the environment; or result in damage to

or loss of equipment, property or personnel. Hazardous wastes are substances that have been "abandoned, recycled, or are inherently waste like," and due to their quantity, concentration and/or characteristics, may cause increases in mortality or serious irreversible illness, or pose a substantial hazard to human health or the environment if improperly treated, stored, transported or disposed of.

3.4.1 Overview

Hazardous Materials and Waste

A hazardous material is any material whose physical, chemical, or biological characteristics, quantity, or concentration may cause or contribute to adverse effects in organisms of their offspring; pose a substantial present or future danger to the environment; or result in damage to or loss of equipment, property, or personnel. Hazardous materials and waste management activities at Edwards AFB are governed by specific environmental regulations including RCRA (42 United States Code [USC] 6901); CERCLA (42 USC 9601); the Federal Facility Compliance Act of 1992 (FFCA) (Public Law 102-386); AFI 32-7086, Hazardous Materials Management; 40 CFR 260-299, Storage, Treatment and Disposal of Waste; and 49 CFR 171-185, Waste Transportation and Packaging.

The use of hazardous materials results in generation of hazardous waste (e.g., paint waste, used oil, contaminated rags, etc.) and requires proper handling. The USEPA enforces the RCRA (40 CFR 260-272), which provides guidelines for the generation, storage, transportation and disposal of hazardous waste. The California Environmental Protection Agency (Cal-EPA) enforces hazardous waste laws embodied in 22 California Code of Regulations (CCR) Chapters 10-20 and the California Health and Safety Code (Section 25100). Environmental Management manages hazardous waste accumulation.

Guidelines used by Edwards AFB include the Edwards AFB Hazardous Waste Management Plan (HWMP) (USAF 2010b), which was prepared in accordance with AFI 32-7042, *Waste Management*. The HWMP contains requirements for solid and hazardous waste characterization, training, accumulation, turn-in and disposal, as well as procedures for inspections, permits and recordkeeping. It is intended to ensure compliance with applicable Federal, State and Local

regulations; simplify administrative procedures; and reduce pollution and environmental impacts through improved waste management practices.

Environmental Restoration Program (ERP)

The ERP identifies, investigates and remediates releases of hazardous substances associated with past DoD activities.

As part of past practices at Edwards AFB that included aircraft research and development, a number of waste disposal sites have been identified. For example, the Main/South Base at the western edge of Rogers Dry Lake is primarily used for maintaining and refueling aircraft. The North Base, located 5 miles northeast of the Main Base area, had a drum storage site at the northern end of Rogers Dry Lake and three unlined surface impoundments where wastes were poured during the 1960s and 1970s. In the past, large amounts of fuel and solvents have been spilled and poor disposal practices have resulted in the release of volatile organic compounds (VOCs), metals, and other chemicals to the ground. The AFRL and Leuhman Ridge where rocket engine testing activities resulted in four major and extensive groundwater contamination plumes containing perchloroethene (PCE), trichloroethene (TCE), and perchlorate plus dense, non-aqueous phase liquids (DNAPLs) in fractured bedrock, an abandoned sanitary landfill containing heavy metals and an area where electroplating wastes were dumped (United States Environmental Protection Agency 2016). Many of these areas have been cleaned up although numerous restoration activities are ongoing.

In 1989, the USEPA listed Edwards AFB on the National Priorities List under CERCLA. A Federal Facilities Agreement (FFA), which became effective in October 1990, was subsequently negotiated among Edwards AFB, USEPA, California Regional Water Quality Control Board-Lahontan Region (CRWQCB), and the California Department of Toxic Substances Control (DTSC). In accordance with the FFA, the USEPA and state agencies (DTSC and CRWQCB) provide oversight of the investigation and restoration activities. The USEPA and state agencies jointly oversee all CERCLA sites at Edwards AFB, while the CRWQCB oversees the petroleum sites managed under the Air Force Compliance Restoration Program (CRP). Prior to 2013, petroleum sites under the Air Force CRP at Edwards AFB were under the regulatory oversight of

Kern County Environmental Health Services Department. Beginning in 2013, regulatory oversight of the petroleum-only CRP sites was transferred to the CRWQCB (Tetra Tech, 2014).

Currently, there are 10 Operable Units (OUs) listed below that have been identified by the Air Force at Edwards AFB (Figure 3.4-1):

- OU1 and OU8 – Main Base/Flightline Area and Northwest Main Base
- OU2 – South Base
- OU3 – Basewide Water Wells
- OU4 and OU9 – AFRL Sites
- OU5 and OU10 – North Base
- OU6 – NASA Dryden
- OU7 – Basewide Miscellaneous Sites.

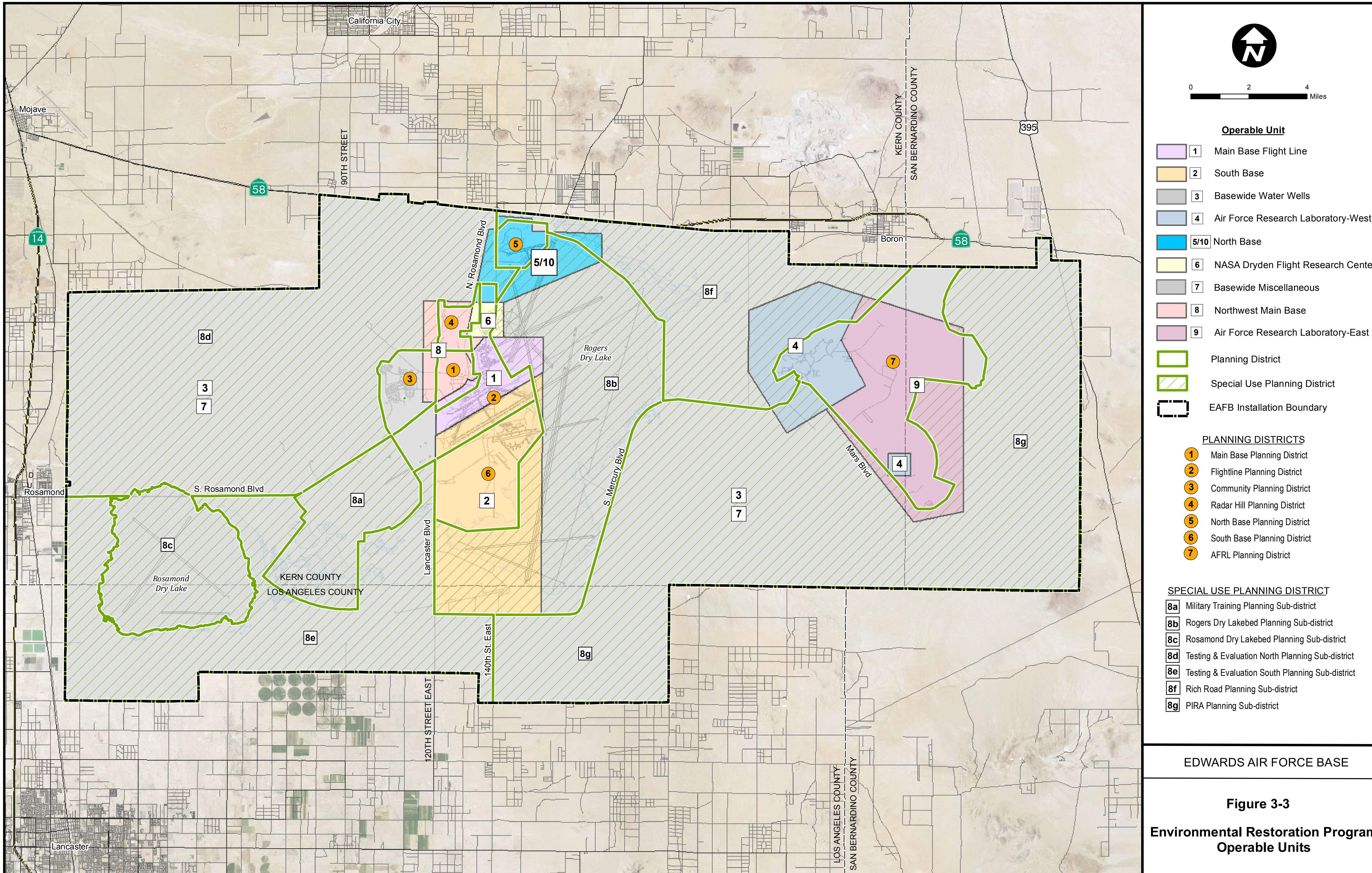
Many of the sites within the OUs have been cleaned up although numerous restoration activities are ongoing. Table 3-4 provides a summary of the OUs at Edwards AFB, contaminants of concern by OU, total sites identified by OU and those sites that are open (in the process of cleanup) and those that are closed.

A Record of Decision (ROD) is a legal document signed by Edwards AFB, USEPA, DTSC and the CRWQCB that identifies the selected methods for long-term cleanup or management of contamination at a site or OU. Fourteen RODs have been defined to address all contaminated sites in the 10 OUs. Currently, eight RODs have been signed.

3.4.2 Hazardous Materials and Waste Issues within each Planning District

Main Base Planning District

Portions of the OU6-NASA/Dryden and OU8-Main Base/Flightline Area and Northwest Main Base ERP sites lie beneath the Main Base Planning District (Table 3-3). Investigations in OU6 included groundwater testing for trichloroethene and benzene. RODs for groundwater cleanup have been signed and cleanup actions are underway (Environmental Protection Agency, 2016).



EDWARDS AIR FORCE BASE

Figure 3-3

Environmental Restoration Program Operable Units

Five contaminated groundwater plumes are associated with OU8. Contaminants include volatile organic compounds (VOCs), petroleum-related products, 1,4-dioxane and NDMA. Two RODs are planned for OU8 to address miscellaneous soil and groundwater sites. In 2012 the AF determined that some groundwater plumes from OU8 are mingling with at least one of the OU1 plumes. The AF now plans to amend the OU1 Feasibility Study and combine these OU8 plumes in a Feasibility Study Addendum and a combined OU1/OU8 Proposed Plan (Environmental Protection Agency, 2016).

Flightline Planning District

Portions of the OU6-NASA/Dryden, OU8-Main Base/Flightline Area and Northwest Main Base and OU5/OU10-North Base and OU1 Main Base/Flightline ERP sites lie beneath the Flightline Planning District (Figure 2-3). In OU6, the main contaminants of concern are TCE, and benzene. In 2006, EPA signed a groundwater cleanup ROD involving three source sites. Three other sites were identified for no action. As indicated earlier, five contaminated groundwater plumes are associated with OU8. Contaminants include VOCs, petroleum-related products, 1,4-dioxane and NDMA. Two RODs are planned for OU8 to address miscellaneous soil and groundwater sites. In 2012, the AF determined that some groundwater plumes from OU8 are mingling with at least one of the OU1 plumes. The AF now plans to amend the OU1 Feasibility Study and combine these OU8 plumes in a Feasibility Study Addendum and a combined OU1/OU8 Proposed Plan (Environmental Protection Agency 2016). There are three main groundwater plumes in OU5/OU10. Known or suspected contaminants consist of benzene, carbon tetrachloride, nitrates, TCE, cis-1,2-Dichloroethene, other VOCs, and perchlorate. The proposed plan for cleanup for public comment is expected in 2018 (Environmental Protection Agency, 2016).

Community Planning District

The OU8-Northwest Main Base ERP site lies beneath the Community Planning District. As indicated earlier, five contaminated groundwater plumes are associated with OU8. Contaminants include VOCs, petroleum-related products, 1,4-dioxane and NDMA. Two RODs are planned for OU8 to address miscellaneous soil and groundwater sites. In 2012, the AF determined that some groundwater plumes from OU8 are mingling with at least one of the OU1 plumes. The AF now

plans to amend the OU1 Feasibility Study and combine these OU8 plumes in a Feasibility Study Addendum and a combined OU1/OU8 Proposed Plan (Environmental Protection Agency 2016).

Radar Hill Planning District

The OU6-NASA/Dryden and OU5/OU10-North Base ERP sites lie beneath the Radar Hill Planning District. In OU6, the main contaminants of concern are TCE, and benzene. In 2006, EPA signed a groundwater cleanup ROD involving three source sites. Three other sites were identified for no action. There are three main groundwater plumes in OU5/OU10. Known or suspected contaminants consist of benzene, carbon tetrachloride, nitrates, TCE, cis-1,2-Dichloroethene, other VOCs, and perchlorate. The proposed plan for cleanup for public comment is expected in 2018 (Environmental Protection Agency 2016).

North Base Planning District

The OU5/OU10-North Base ERP site lie beneath the North Base Planning District. There are three main groundwater plumes in OU5/OU10. Known or suspected contaminants consist of benzene, carbon tetrachloride, nitrates, TCE, cis-1,2-Dichloroethene, other VOCs, and perchlorate. The proposed plan for cleanup for public comment is expected in 2018 (Environmental Protection Agency 2016).

South Base Planning District

The OU2-South Base site lie beneath the South Base Planning District. Contaminants of concern in this OU are TCE, PCE and carbon tetrachloride. RODs have been signed for cleanup of three groundwater plumes and contamination at a landfill. Four sites have been identified for no-further action.

AFRL Planning District

The OU4 and OU9-AFRL sites lie beneath the AFRL Planning District. These OUs are grouped together due to the similar geology at these areas. Four major plume areas containing TCE, PCE and perchlorate have been identified in addition to a number of soil and debris sites associated with the operations. On September 28, 2007 EPA signed a ROD for a Technical Impracticability ARAR Waiver and Land Use Controls (LUCs) to prevent exposure to vapors in overlying

structures. These decisions involved four source sites within these OUs and were based on the March 2005 Remedial Investigation Report and June 2005 Feasibility Study Report. A Proposed Plan was provided for Public Comment in April 2006. The main contaminants of concern for this OU are TCE, PCE, 1,4-dioxane, perchlorate, benzene and NDMA. In 2008, EPA signed a ROD that selected soil and debris remedies for eight sites located throughout OU4/9. Another 10 sites in these OUs were designated as no action sites. The main contaminants of concern among these soil and debris sites are PCBs, beryllium, perchlorate, and Polycyclic aromatic hydrocarbons. A 2013 Explanation of Significant Differences for polychlorinated biphenyls (PCBs) at Site 312 documented cessation of excavation and the use of LUCs for a small amount of contaminated soil inaccessible beneath a currently established transformer foundation.

Special Use Planning District

The OU3-Basewide Water Wells and OU7-Basewide Miscellaneous Sites are found within this Special Use Planning District. OU3 is defined as the basewide water wells and originally included 660 potential well sites determined from historical records and archival research. Investigation determined that 8 wells were suspected as potential contaminant pathways to groundwater and were further evaluated. No contaminants were found and the selected remedy selected was No Further Action. A ROD was issued in 2003. OU7 involves all sites and base areas not located in one of the other ten OUs. Four areas in this OU have RODs:

- Basewide miscellaneous sites;
- Chemical Warfare Materiel;
- Site 3 Landfill; and
- Basewide Military Munitions Response Program.

Table 3-4
Description of Operable Units (OUs) and Summary of Site Status by OU

Operable Units	Description[1,2]	Total Sites	Open Sites	Closed Sites
OU1/OU8 Main Base/Flightline Areas and Northwest Main Base	There are five main groundwater plumes on the flightline. Contaminants include volatile organic compounds (VOCs) and petroleum related products, 1,4-dioxane and NDMA.	72	29	44
OU2 South Base	Contaminants of concern are trichloroethene (TCE), perchloroethlyene (PCE) and carbon tetrachloride. Records of Decisions have been signed for cleanup of three groundwater plumes and contamination at a landfill. Four sites have been identified for no-further action.	70	9	61
OU3 Basewide Water Wells	This OU is defined as the basewide water wells and originally included 660 potential well sites determined from historical records and archival research. Investigation determined that 8 wells were suspected as potential contaminant pathways to groundwater and were further evaluated. No contaminants were found and the selected remedy selected was No Further Action. A ROD was issued in 2003.[2]	8	0	8
OU4/OU9 AFRL Sites	The Air Force tested rocket engines at this remote ridge in the eastern part of the base. These OUs are grouped together due to the similar geology at these areas. Four major plume areas containing TCE, PCE and perchlorate have been identified in addition to a number of soil and debris sites associated with the operations.	147	24	123
OU5/OU10 North Base	There are three main groundwater plumes in OU5. Known or suspected contaminants consist of benzene, carbon tetrachloride, nitrates, TCE, cis-1,2-Dichloroethene, other VOCs, and perchlorate.	103	31	72
OU6 NASA Dryden	The main contaminants of concern for this OU are TCE, and benzene. In 2006, EPA signed a groundwater cleanup ROD involving 3 source sites. Three other sites were identified for no action	20	TBD	20; closed wells
OU7 Basewide Miscellaneous Sites	This OU involves all sites and base areas not located in one of the other ten OUs. Four areas in this OU have RODs: • Basewide miscellaneous sites; • Chemical Warfare Materiel; • Site 3 Landfill; and • Basewide Military Munitions Response Program.	92	9	83

[1] U.S. Environmental Protection Agency Superfund Site Overview, Edwards, Air Force Base, Pacific Southwest https://yosemite.epa.gov/r9/sfund/r9sfdocw.nsf/vwsoalphabetic/Edwards+Air+Force+Base. Accessed 8/18/16

[22] Edwards Air Force Base, 2003. CERCLA No Action Record of Decision, Operable Unit 3, Basewide Water Wells, Air Force Flight Test Center, Environmental Management.

3.5 INFRASTRUCTURE

This section provides an overview of the existing infrastructure conditions at Edwards AFB, primarily based on the IDP.

3.5.1 Overview

Much of the installation consists of legacy facilities and infrastructure, some of which are nearing the end of their useful lives (Edwards AFB, 2015a; IDP Page 3-6). A summary of the existing infrastructure capacity and condition is provided in Table 3-5 followed by a general discussion of built infrastructure by category. An “adequate” rating indicates that space, facilities, acreage, or system capacity meet existing mission requirements and offer opportunities for development. Alternatively, a degraded rating indicates that space, facilities, acreage, or remaining system capacity is limited and offers limited potential for development or mission expansion.

Table 3-5
Infrastructure Capacity and Condition Summary

Built Infrastructure	Existing Capacity	Condition
Electrical System Generation	Adequate	Degraded
Natural Gas Supply/ Distribution	Adequate	Adequate
Water Supply/Distribution	Not Applicable/ Insufficient Data*	Adequate
Waste Water Discharge/ Sanitary Sewer	Adequate	Adequate
Stormwater Discharge/ Collection	Not Applicable/ Insufficient Data*	Adequate
Roadway Network	Not Applicable/ Insufficient Data*	Adequate
Communications	Adequate	Degraded

Source: IDP Capacity Opportunity Summary (Edwards AFB, 2015a). *Data cannot be quantified to provide a measure of capacity or additional data/information is needed to rate it.

Electrical

Capacity: Construction of the electrical distribution system was completed in the early 1950s. The system serves four distinct areas: Main Base, North Base, South Base, and the AFRL. The system provides a maximum combined peak demand load of 40 megawatts (MW) to these areas. The Western Area Power Authority sends a standard allotment of power to the installation.

Any requirements beyond that allotment are purchased from Southern California Edison (SCE), which delivers power over 115 kilovolt transmission lines to three transmission substations. One station with 52 million volt-ampere (MVA) capacity serves the North and Main Base areas, the second station with 27 MVA capacity serves the South Base, and the third station with 26 MVA serves the AFRL.

The existing system has a maximum capacity of 79 MW, nearly double the 40 MW maximum demand registered for the installation (Edwards AFB, 2015a).

Condition: Although several major distribution system upgrades have been completed since 1990, in some areas the electrical distribution system is still obsolete and major upgrades are needed. The condition of the internal building electrical infrastructure in some older buildings is also failing. Edwards AFB maintains 55 emergency power generators with a total capacity of 12,775 kilowatts (kW) located throughout the installation, including the AFRL. These units start, transfer power, and stop automatically during power outages. Most units are powered by diesel fuel, with two fueled by natural gas, and one with propane. In addition, there are 39 Mobile Electric Power units, with a total capacity of 4,900 kW, stored for emergency use.

In general, the electrical system has adequate capacity but the electrical distribution system and individual building electrical systems are in degraded condition and in need of improvement.

Natural Gas

Currently, there is an adequate natural gas supply and distribution capacity. Most piping installed in the 1990s is still in good or excellent condition.

Capacity: The natural gas distribution system delivers gas for domestic and industrial uses. It also serves the compressed natural gas facility for the natural gas vehicle fleet. The total annual consumption of natural gas was 316 million cubic feet (MCF) in fiscal year 2014. Industrial use consumes 75 percent of the demand, with commercial and residential uses consuming the remainder.

Condition: Overall, the condition of the natural gas distribution system is very good. PG&E installed the AFRL natural gas distribution system in 1995 using polyethylene pipe. In 1992,

PG&E replaced the gas distribution system for Main Base, South Base, and privatized housing areas with polyethylene pipe. The piping in these areas is in very good condition; the valves and regulators are in good condition. At North Base, PG&E installed the gas distribution system in 1998 using polyethylene pipe and the system is in very good condition. The valves and regulators are in good condition.

Water Supply/Distribution System

Capacity: The installation water system consists of approximately 120 miles of transmission mains and smaller supply lines. A substantial percentage of these lines were constructed in the 1950s. Mains constructed of various materials range in size from 6 to 30 inches. Asbestos cement (transite), cast iron, and polyvinyl chloride pipe are the most common materials in the system. Smaller lines (4 inches and smaller) supply individual structures, production, and warehouse facilities. The system includes main line valves, air release/vacuum relief valves, pressure-reducing valves, fire hydrants, blow-down valves, and elevated and ground storage facilities.

The installation sources water from on-base deep wells and the Sacramento Delta via the Antelope Valley-East Kern (AVEK) Water Agency. There are four on-base well fields providing water to the installation:

- South Base Well Field – seven wells
- South Track Well Field – two wells
- AFRL Well Field – four wells (one currently not in use)
- Graham Ranch Well Field – three wells

Because of some older pipes and/or long line lengths in comparison to low water flow, six auto-flushers are used on the water distribution system to maintain water quality. Each auto-flusher discharges an estimated 30,000 gallons of water per week, for a total 9.36 million gallons of water per year.

Condition: Sections of the original problematic parts of the distribution system have been cleaned, repaired, or totally replaced. Polyvinyl chloride pipe has been used to replace the majority of the lines. However, many sections are old and frequently leak, particularly along the

flightline area, which result in standing water, creating a bird habitat, and bird-aircraft strike hazard (BASH). Recently, approximately 17,000 linear feet of old cast iron piping was replaced with new, corrosion-resistant polyvinyl chloride piping. This resulted in improved water quality and firefighting flow capability to multiple areas.

The water distribution system does not have adequate isolation valves and the current loop configuration does not work as well as it could. Though inadequately located, valves are tested annually and range from good to poor condition. Fire hydrants are adequately located and many have been recently replaced. There are two inactive chloramine pumping stations, one on Mercury Boulevard and one at Building 791.

Wastewater Discharge/Sanitary Sewer System

Capacity: The California Water Quality Control Board Lahontan Region regulates wastewater treatment and discharge for the base's two wastewater treatment plants. The main waste water treatment plant (WWTP) is located at South Base and is the primary system serving the Main Base, privatized housing, North Base, and South Base. The South Base WWTP has a design capacity of 2.5 million gallons per day (MGD) and currently treats an average of 450,000 gallons per day (GPD). Effluent from the South Base WWTP is reclaimed and used at Muroc Lake Golf Course and other irrigated areas. Effluent not used for reclaimed purposes is discharged to 250 acres of evaporation ponds located near the southern edge of Rogers Dry Lake. A second WWTP is located at and serves the AFRL. The AFRL WWTP has a design capacity of 0.125 MGD and currently treats an average of 0.060 MGD. Effluent can be discharged to four evaporation ponds at the site. Overall, existing wastewater treatment systems are adequate to meet current needs and future requirements.

Condition: The South Base WWTP includes a single lift station, gravity collection lines serving the hangars and smaller facilities, and force main. The South Base collection lines, constructed in the 1950s, are vitrified clay with a combination of brick and concrete manholes. The pipes and manholes are in poor condition. On the Main Base, the sanitary sewer lift stations were constructed in the mid-1950s to the early 1960s. New pumps, motors, and controls have been added to upgrade the lift stations since their construction and they are in good condition.

The wastewater system on the North Base was constructed in the 1940s. The system includes 4-to-8-inch gravity collection and force main lines and three lift stations. The system's vitrified clay pipe and brick manholes are in fair condition.

The AFRL treatment plant uses an activated sludge process with sand filters that produce a tertiary effluent. Pumps are used to dispose of this effluent into evaporation ponds. A contractor operates the plant efficiently and it is in excellent condition. The collection lines are vitrified clay pipes installed in the 1940s. The lines are in fair condition, with depths varying between 3 to 20 feet. Manholes are a combination of brick and concrete and are also in fair condition. There are a number of septic systems at the AFRL that could be replaced with waste water lines to the WWTP.

Stormwater Discharge/ Collection System

Capacity: The stormwater drainage system consists primarily of drainage ditches with some storm sewer structures in the developed areas. These ditches and storm sewers generally flow west to east and empty into the Rogers Dry Lake, or the stormwater retention ponds east of the Main Base flightline. Stormwater runoff in undeveloped areas flows into the nearest dry lake.

Stormwater is collected and transmitted through earthen channels and drainage structures. The local topography prevents the efficient use of traditional stormwater drainage improvements. The level terrain prevents flows from achieving velocities sufficient to keep the channels clear.

Condition: The easily-eroded soil in the undeveloped, upstream areas of the installation tends to cause the drainage channels to fill with silt, which leads to flooding. Areas prone to flooding include the dry lakebeds, Mojave Creek, South Base, and low-lying areas in the western portion of the Main Base industrial area.

Installation Road Network

No transportation network study has been completed to determine the existing Level of Service (LOS) of specific roads and intersections and the condition of the pavement. However, the overall condition of the road network is adequate.

Capacity: The installation road network consists of 12,530,558 square yards of pavement. Two primary roads, Rosamond Boulevard and Lancaster Boulevard, carry the majority of base traffic, including the transportation of explosives. Six secondary roads distribute traffic from the primary roads to the residential areas, flightline areas, and North and South Base areas. Mercury Boulevard and Rich Road are the two primary roads accessing the AFRL, and provide local community access through the installation without passing through a security access gate. All other roads are classified as tertiary, feeder, or unpaved roads serving individual areas on the installation. Access to the AFRL complex is constrained by a railroad crossing at Rich Road, and Mercury Boulevard is subject to closures associated with active range usage. There is no base taxi, public bus, or on-base shuttle service.

Condition: Some roadway pavement and signage are in poor condition and in need of substantial upgrades, but the condition of most major roads on the installation is considered adequate.

Communication

The existing communications infrastructure is somewhat degraded, but it is currently being improved and expanded.

Capacity: The communications infrastructure has been improved and is adequate for the current mission.

Condition: Existing buildings are old and in poor condition. The installation has made great progress in improving communications and data infrastructure, which is critical to base operations. In addition to the expansion of fiber-optic cable throughout the base, switches have been revamped in the installation network, and there are plans to consolidate the 412th Communications Squadron (412 CS) data center.

3.5.2 Infrastructure within or near each Planning District

All types of infrastructure discussed for the entire installation occur in each of the Planning Districts.

3.6 LAND USE

This section provides an overview of the existing land use conditions at Edwards AFB and within each proposed planning district.

3.6.1 Overview

Regional Setting and Off-Base Land Use

As previously discussed, the majority of the installation is in Kern County, with smaller areas located within Los Angeles and San Bernardino Counties. The land adjacent to the installation consists of rapidly growing communities and arid desert. The communities of Boron, California City, Lancaster, Mojave, Palmdale, and Rosamond pose potential encroachment threats if growth is not properly managed. Edwards AFB works with local communities, government agencies, and non-profit organizations to proactively manage potential encroachment.

Installation Land Use

The installation is organized into five distinct developed areas: Main Base, North Base, South Base, Community, and the AFRL. The remainder of Edwards AFB is largely undeveloped, but serves essential functions such as military ranges or RDT&E of aircraft. The most dominant features on Edwards AFB are the large airfield and dry lakebeds, with their associated runways, taxiways, and aprons covering a majority of the main cantonment area. Parking aprons for test aircraft are bordered to the west and northwest by airfield operations and maintenance land uses, including large hangars, parked aircraft, and maintenance units (Edwards AFB, 2015a).

The central area of the installation includes administrative facilities that support ongoing test missions, which are primarily located on Wolfe Avenue. Other wing facilities are located along the main Base road, Rosamond Boulevard, which leads from the community of Rosamond through the West Gate (the main gate) to the Main Base, exiting onto Highway 58 through the North Gate. Industrial facilities are distributed throughout the Main Base area and include warehouses, fuel storage facilities, and the civil engineer complex. NASA AFRC is located to the north of the Main Base area and includes its own administrative, hangar, and test facilities.

Fitz-Gerald Boulevard is the “Main Street” of the residential area of the installation and connects the industrial and airfield-related land uses of the Main Base flightline area to the community-focused residential area. The community area includes privatized housing, public schools, lodging, outdoor recreational facilities, and open space. Medical facilities are located to the southwest of the community area. Community functions are geographically separated from incompatible mission-critical land uses associated with the airfield. Retail and service facilities located in the community area are accessible to the entire installation, although somewhat removed from the flightline.

North Base, which includes a ramp and landing strip, is the smallest of the three airfield areas. It has recently been used as a transient site for several test missions of shorter duration. The larger South Base complex has its own ramp and hangar area with associated administrative and maintenance facilities. South Base is currently transitioning to a new test mission.

The AFRL complex is several miles east of Main Base. Its mission is to test liquid and solid rocket fuels and requires a remote location. The complex is accessed via Rocket Site Road or Mercury Boulevard and has its own entrance gate. It includes administrative facilities, laboratories, maintenance facilities, and test facilities.

Beyond these developed areas are several thousand acres of RDT&E land. Although this land may appear to be open space, it supports an essential function by enabling safe testing of numerous aircraft. Most land in this classification is part of ranges, such as the PIRA to the east or the small arms training range south of Rosamond Boulevard. In some areas, when there is no active testing, portions of the land are used for outdoor recreational activities (Edwards AFB 2015).

3.6.2 Land Use within each Planning District

Table 3-6 provides a brief overview of land use within each Planning District. Section 2.2, Planning District Overview, provides additional details and figures for each planning district including geographic location, general description of facilities, and potential land use issues and constraints.

Table 3-6
Existing Land Use Within Each Planning District

Planning District	Land Uses
Main Base	Mixture of administrative, light industrial, community (services), housing (unaccompanied), outdoor recreation and open space.
Flightline	Primarily aircraft operations and maintenance with some small pockets of industrial uses and open space corresponding to airfield safety clearances.
Community	Mixture of housing (accompanied), community (commercial), community (services), medical, outdoor recreation and open space.
Radar Hill	Primarily industrial and open space, but most of the district is open for off-road vehicle (ORV) recreational use.
North Base	Almost exclusively aircraft operations and maintenance.
South Base	Predominantly industrial because of the munitions complex, but the district includes airfield, aircraft maintenance and operations and open space uses.
AFRL	All of the AFRL Planning District land use is designated as aerospace research and development.
Special Use	Mostly-undeveloped lands

3.7 NATURAL RESOURCES

3.7.1 Overview

The following section provides information on vegetation and wildlife communities occurring on Edwards AFB, followed by more detailed information for sensitive species potentially affected by the proposed project, implementation of the IDP. The analysis of the proposed project's potential impacts on natural resources, as well as the recommendations for avoidance, reduction of, or mitigation measures necessary to address these potentially adverse impacts are provided in Section 4.7. The information provided in this section is based primarily on the Edwards AFB Integrated Natural Resources Management Plan (INRMP) (Edwards Air Force Base, 2016).

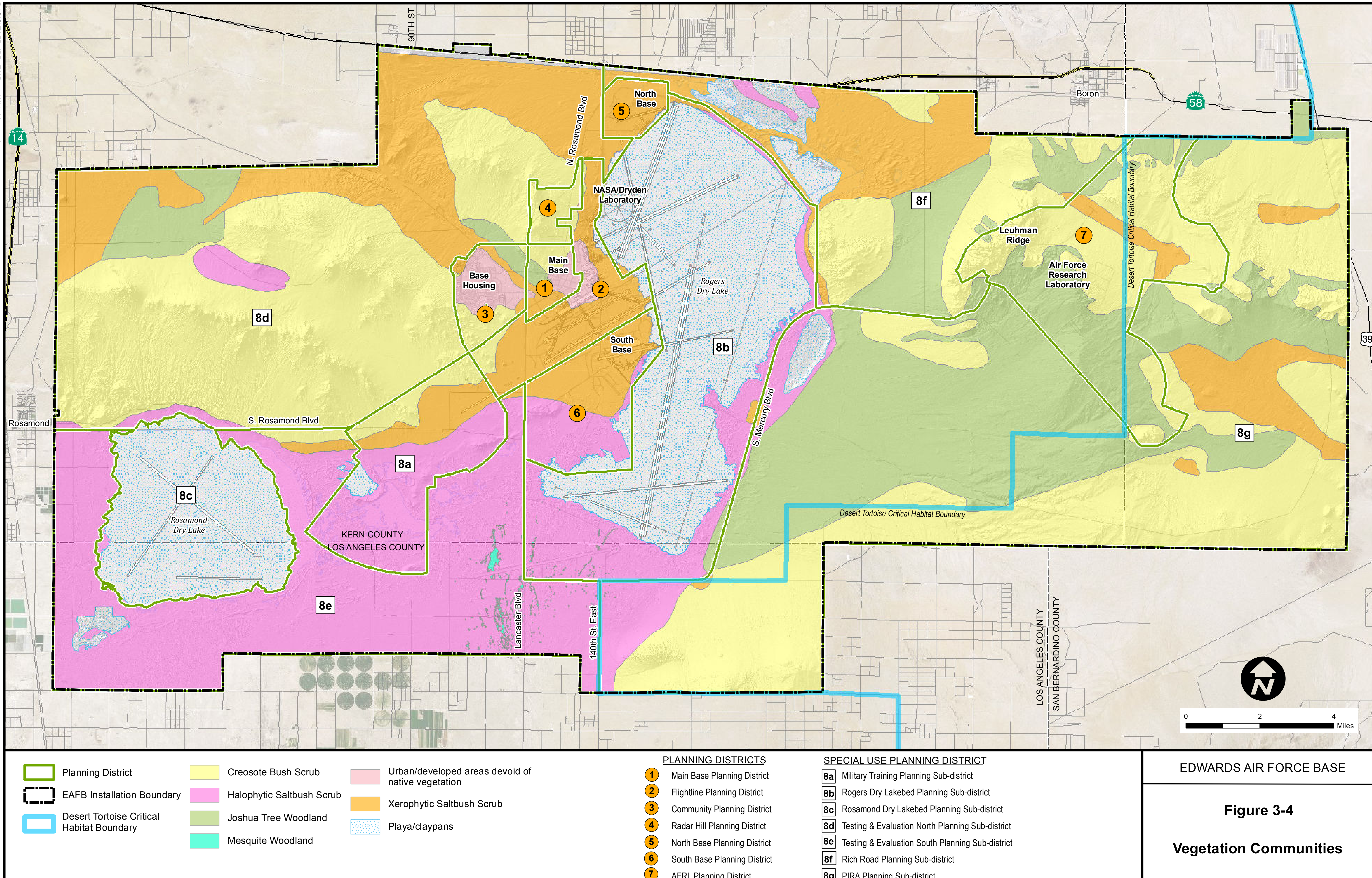
3.7.2 Vegetation

Vegetation communities found in each planning district of the IDP are summarized in Table 3-7 and shown on Figure 3-4. These communities are discussed in greater detail in the INRMP. Generally, the special use districts support less disturbed native vegetation communities and greater species diversity, while those communities in more developed areas (including the remaining seven planning districts) support disturbed native vegetation and more non-native species.

Table 3-7
Vegetation Community Acreage in each IDP Planning District

Planning District	Creosote Bush Scrub	Joshua Tree Woodland	Saltbush Scrub		Mesquite Woodland	Playas and Claypans	Urban and Unvegetated	Totals	Percent of Total
			Xerophytic Phase	Halophytic Phase					
Main Base	435	246	366	-	-	-	401	1,047	0.3%
Flightline	552	-	4,913	-	-	286	564	5,751	1.9%
Community	803	309	394	-	-	-	1,384	1,506	0.5%
Radar Hill	1,252	-	18	-	-	-	-	1,270	0.4%
North Base	-	-	1,503	-	-	73	-	1,576	0.5%
South Base	-	-	3,068	2,665	-	913	-	6,646	2.2%
AFRL	9,310	6,941	1,071	-	-	-	-	17,322	5.7%
Special Districts	90,413	45,232	33,927	54,777	276	44,586	5	269,211	88.5%
Total	102,765	52,728	45,260	57,442	276	45,858	2,354	304,329	100%
Percent of Total	33.8%	17.3%	14.9%	18.9%	0.1%	15.1%	0.8%	100.0%	

Note: Urban and unvegetated numbers may be low as they generally do not include linear features such as roads or smaller undisturbed areas, nor include disturbed native vegetation adjacent to developed areas.



EDWARDS AIR FORCE BASE

Figure 3-4

Vegetation Communities

3.7.3 Wildlife Communities

Wildlife communities are typically more abundant and diverse in the Special Use Planning District than in the other planning districts as this area is less disturbed and supports larger areas of native vegetation with greater species diversity. Comprehensive lists of wildlife species found on the installation are found in the Appendices of the INRMP.

3.7.4 Common Species and Habitats

No fish occur naturally on Edwards AFB and none are likely to be found in any Planning Districts. Common invertebrates found at Edwards AFB include insects such as wasps, ants, bees, flies, grasshoppers, moths, butterflies, and beetles; and arthropods including spiders, scorpions, and fairy shrimp, although no sensitive species of fairy shrimp have been identified on Edwards AFB. Amphibians could be found in those areas that support permanent or seasonal water, including playa/claypan areas of the installation and include the native Pacific tree frog (*Hyla regila*) and western toad (*Bufo boreas*), as well as the non-native African clawed frog (*Xenopus laevis*) and American bullfrog (*Rana catesbeiana*) (AMEC Earth and Environmental, 2008). Reptiles common to Edwards AFB include the long-nosed leopard lizard (*Gambelia wislizenii*), side-blotched lizard (*Uta stansburiana*), western whiptail (*Cnemidophorus tigris*), zebra-tailed lizard (*Callisaurus draconoides*), coachwhip (*Masticophis flagellum*), gopher snake (*Pituophis melanoleucus*), and Mojave green rattlesnake (*Crotalus scutulatus*).

Common native bird species common to Edwards AFB and likely to inhabit or be observed as flyovers or foraging in the Planning Districts include, mourning dove (*Zenaida macroura*), Anna's hummingbird (*Calypte anna*), horned lark (*Eremophila alpestris*), common raven (*Corvus corax*), cactus wren (*Campylorhynchus brunneicapillus*), house finch (*Carpaiacus mexicanus*) and white-crowned sparrow (*Zonotrichia leucophrys*). In addition, non-native species such as the house sparrow (*Passer domesticus*) and European starling (*Sturnus vulgaris*) are often present in the developed Planning Districts.

Common mammal species at Edwards AFB include bats found in some of the abandoned structures in the Planning Districts; carnivores such as the coyote (*Canis latrans*), desert kit fox (*Vulpes macrotis*), bobcat (*Lynx rufus*), and American badger (*Taxidea taxus*); and small

mammals, including the black-tailed jackrabbit (*Lepus californicus*), desert cottontail (*Sylvilagus audubonii*), desert woodrat (*Neotoma lepida*), Merriam's kangaroo rat (*Dipodomys merriami*), and white-tailed antelope ground squirrel (*Ammospermophilus leucurus*).

3.7.5 Sensitive Species and Habitats

<u>Sensitive Species</u>

Sensitive species included in this document are those listed by the Federal, State, or Local governments or those in planning processes as endangered, threated, or otherwise of conservation concern, including:

- Species listed by the California Native Plant Society (CNPS)
- Species designated as either rare, threatened, or endangered by CDFW and/or the USFWS, and are protected under either the California or Federal Endangered Species Acts
- Candidate species or species being considered or proposed for listing under these same Acts
- Species listed as Birds of Conservation Concern (BCC) by USFWS
- California Species of Special Concern (SSC) listed by CDFW
- Species covered in U.S. Bureau of Land Management (BLM) regional programmatic planning documents such as the West Mojave Plan (WEMO) or the Desert Renewable Energy Conservation Plan (DRECP).

Edwards AFB supports habitats that have the potential to support approximately 13 species of sensitive plants (Table 3-8) and 29 species of sensitive wildlife (Table 3-9). Of these, five sensitive plants and 23 sensitive wildlife have been found within the past ten years on the base, and are described as present on these tables. Not all of these species have the potential to be present in every Planning District. Each species has been given a potential to occur in each Planning District based on the following definitions:

- Present — Species was observed during a survey in the past ten years within the Planning District or its immediate vicinity (approximately one mile), or recorded as occurring on the Base installation in the INRMP.
- High — Both a historical record exists of the species within the boundaries of the Planning District or its immediate vicinity *and* the environmental conditions (including vegetation, soil type and elevation factors) associated with the species are found within that Planning District.

- Moderate — Either a historical record exists of the species within the immediate vicinity of the Planning District *or* the environmental conditions associated with species are found at the Planning District.
- Low — No records exist of the species occurring within the Planning District or its immediate vicinity and/or the environmental conditions associated with species presence are marginal or highly disturbed within the Planning District.
- Absent — Species was not observed during focused surveys conducted within the Planning District at an appropriate time and/or the environmental conditions associated with species presence do not exist on or in the immediate vicinity of to the Planning District.

Only those species listed as present have been recorded on Edwards AFB within the past ten years. Where a species has the potential to occur in portions of a Planning District, such as specific microhabitats, wetlands, etc., the species has been given the highest potential to occur for the Planning District as a whole. Of the species listed on Table 3-8 and Table 3-9, those of greatest concern are Federally-listed species, which includes the desert tortoise, golden eagle, and California least tern, discussed individually in the following paragraphs.

Desert tortoises are listed as threatened under both the Federal and State Endangered Species Acts and desert tortoise habitat is found throughout all undeveloped portions of the installation. Surveys for desert tortoise indicate the species occurs throughout the installation, although densities vary the highest densities are in the southcentral and southeastern areas. The southwestern and northwestern corners of the installation and the Main Base area contain the lowest density levels. Tortoises are absent from the lakebeds, including Rosamond Dry Lake.

Golden eagles are protected under the Federal Bald and Golden Eagle Protection Act, are Fully Protected by the state, and inhabit a wide range of habitats. Urbanization and human-population growth have made areas historically used by eagles unsuitable, particularly in southern California. Extensive agricultural development reduces jackrabbit populations (the main prey of the golden eagle) and makes areas less suitable for nesting and wintering eagles. Recreation and other human activity near nests can cause breeding failures. Golden eagle foraging habitat could occur within all Planning Districts, with potential nesting habitat only found in the areas of steepest cliffs such as in the Rosamond Hills and Leuhman Ridge.

The California least tern is listed as endangered under the Federal Endangered Species Act. They feed in aquatic areas that are abundant with fish, and nest close to water usually in open areas. On Edwards AFB, individuals have been observed in the Piute Ponds, Branch Park and dry lakebed areas, although it is unknown if this species has nested on Edwards AFB.

Table 3-8
Sensitive Plant Species Potential for Occurrence in Planning Districts

Scientific Name Common Name	Status	Flowering Period Habitat Locations on EAFB	Potential for Occurrence							
			Main Base	Flightline	Community	Radar Hill	North Base	South Base	AFRL	Special Use*
Astragalus preussii Lancaster milkvetch	Federal: None State: None CNPS: 1B.1	March – May Areas of high water table in saltbush scrub Found in lowlands south of Rogers Dry Lakebed	Low	Moderate	Low	Low	Moderate	High	Low	Present
Calochortus striatus alkali mariposa lily	Federal: None State: None CNPS: 1B.2	April – June Claypans and sand dunes in saltbush scrub, drainages Western portions of EAFB	Moderate	Present	Low	Low	Moderate	Present	Low	Present
Canbya candida white pygmy poppy	Federal: None State: None CNPS: 4.2	March – June Joshua tree woodlands; granitic soils; Mojave Desert scrub East-central portion of EAFB	Low	Moderate	Moderate	Moderate	Moderate	Low	High	High
Cymopterus deserticola desert cymopterus	Federal: None State: None CNPS: 1B.2	March – May Joshua tree woodlands; sandy soils Central and eastern portions of EAFB	Present	Moderate	Moderate	Low	Low	Low	Present	High
Delphinium recurvatum recurved larkspur	Federal: None State: None CNPS: 1B.2	March – June Alkaline soils, chenopod scrub, cismontane woodlands, grasslands Northwest portion of EAFB	Low	Low	Low	Low	Low	Low	Low	High
Eriastrum rosamondense Rosamond eriastrum	Federal: None State: None CNPS: 1B.1	April – July Occurs on alkaline hummocks and vernal pool edges Southwestern and south-central portions of EAFB	Low	Moderate	Low	Low	Moderate	Moderate	Low	Present
Eriophyllum mohavense Barstow woolly sunflower	Federal: None State: None CNPS: 1B.2	March – May Prefer gravelly soils in scrub habitat and playas; Edges of bare areas in saltbush scrub mostly in northwestern portion of EAFB	Moderate	Moderate	Low	Low	Moderate	High	High	High
Eschscholzia minutiflora ssp. *twisselmannii* red rock poppy	Federal: None State: None CNPS: 1B.2	March – May Rocky and gravelly soils in Mojave Desert scrubs One record on EAFB west of Rogers Dry Lake	Moderate	Present	Low	Moderate	Low	Low	Moderate	High
Goodmania luteola yellow spiny cape (golden goodmania)	Federal: None State: None CNPS: 4.2	April – August Prefers alkaline or clay soils within Mojave Desert scrub, meadow sand seeps, playas, and grasslands Limited to salt-encrusted, rolling sandy areas southwest of Rogers Dry Lake	Low	Low	Low	Moderate	Moderate	High	Low	High
Loeflingia squarrosa var. *artemisiarum* sagebrush loeflingia	Federal: None State: None CNPS: 2.2	April – May Dunes in saltbush scrub Southwestern and eastern portions of EAFB	Low	Low	Low	Low	High	High	Present	High
Muilla coronata crowned onion	Federal: None State: None CNPS: 4.2	March – April Joshua tree woodlands, creosote scrub habitats with sandy soils Northeast portions of EAFB	Low	Low	Low	Low	Low	Low	Moderate	High
Nemacladus gracilis slender threadplant	Federal: None State: None CNPS: 4.3	March – May Rocky and sandy soils in Joshua tree woodlands and Mojave Desert scrub Northeast portion of EAFB, including the Leuhman Ridge area	Low	Low	Low	Low	Low	Low	Moderate	High
Plagiobothrys sp popcorn flower	Federal: None State: None CNPS: 1B.1	March – November Joshua tree woodland and Great Basin scrub; Unknown species of popcorn flower found on EAFB	Moderate	Moderate	Low	Low	Low	Low	Moderate	High

Sources: Edwards AFB, 2016; California Native Plant Society (CNPS), 2016; California Natural Diversity Database (CNDDB) 2016, M. Hailstone, personal communication 2017
Notes: *If a species is not listed as present it has not been recorded at the base during the past ten years, rather it's potential to occur was based on those factors listed in this section.
*****The Special Use Planning Area is very large, covering 88.5% of the Base and the potential for occurrence of each species is dependent on the specific vegetation communities, soils, elevation and disturbance levels in the localized area of the proposed activity. Where a species has the potential to occur in specific microhabitats, wetlands, etc., in the Special Use Planning Area, the species has been given the highest potential to occur for the Special Use Planning Area as a whole.
CNPS Status:
List 1B Plants rare, threatened, or endangered in California and elsewhere.
List 2 Plants rare, threatened, or endangered in California but more common elsewhere.
List 4 Plants of limited distribution, a watch list.
CNPS includes a decimal threat ranking with the List ranks to parallel the nomenclature used by the CNDDB. This extension replaces the E (Endangerment) value from the R-E-D Code. CNPS ranks therefore read like this: 1B.1, 1B.2, etc.
New Threat Code extensions and their meanings:

- .1 – Seriously endangered in California (over 80% of occurrences threatened / high degree and immediacy of threat)
- .2 – Fairly endangered in California (20-80% occurrences threatened)
- .3 – Not very endangered in California (<20% of occurrences threatened or no current threats known)

Table 3-9
Sensitive Wildlife Species Potential for Occurrence in Planning Districts

Scientific Name Common Name	Status	Habitat Locations on EAFB	Potential for Occurrence							
			Main Base	Flightline	Community	Radar Hill	North Base	South Base	AFRL	Special Use*
Invertebrates										
Branchnecta coloradenis Colorado fairy shrimp	Federal: None State: None Local: Locally rare	Ephemeral ponded water in claypans Found near Rogers Dry Lake and playas in northwest portions of EAFB	Low	Moderate	Absent	Absent	High	Moderate	Absent	Present
Reptiles										
Gopherus agassizii desert tortoise	Federal: Threatened State: Threatened Local: WEMO, DRECP	Desert scrubs and wash vegetation with friable soils Found throughout undeveloped portions of EAFB	Low	Low	Present	Present	Present	Low	Present	Present
Uma scoparia Mojave fringe-toed lizard	Federal: BLM Sensitive State: SSC Local: WEMO, DRECP	Sandy soils and dunes with Mojave Desert scrub No known locations on the base – potential habitat occurs in the north-central areas of EAFB	Low	Low	Low	Low	Moderate	Low	Low	Moderate
Birds										
Agelaius tricolor tricolored blackbird	Federal: BCC, BLM Sensitive State: SSC (formerly emergency listed as endangered in 2014 and currently under consideration for listing) Local: WEMO, DRECP	Central Valley of California and its vicinity and foothills; Observed nesting on EAFB at Branch Memorial Park Pond in 2014	Low	Low	High	Low	Low	Low	Low	Present
Aquila chrysaetos golden eagle	Federal: BGEPA, BCC BLM Sensitive State: Fully Protected Local: WEMO, DRECP	Nests on cliff faces; forages in grasslands and open habitats Migratory on EAFB; may nest on cliff faces in spring; observed occasionally foraging on EAFB	Low	Low	Low; foraging moderate	Low; foraging moderate	Low; foraging moderate	Low; foraging moderate	Moderate	Present
Asio flammeus short-eared owl	Federal: None State: SSC Local: WEMO, DRECP	Marshes and seasonal wetlands Observed near Piute Ponds	Low	Low	Moderate	Low	Low	Low	Low	Present
Asio otus long-eared owl	Federal: None State: SSC Local: WEMO, DRECP	Nesting in large trees; foraging in most habitats Mesquite woodlands and dense Joshua tree woodlands such as those near Haystack Butte and; also observed foraging at the South Base evaporation ponds	Low	Low	Moderate	Low	Low	Present (foraging)	Low	Present
Athene cunicularia burrowing owl	Federal: BCC State: SSC Local: WEMO, DRECP	Nesting in burrows in the ground or open holes, pipes, etc.; foraging in most open habitats; Observed throughout EAFB in open habitats	Present	Present	Present	Present	Present	Present	Present	Present
Aythya americana redhead	Federal: BCC State: SSC Local: None	Found throughout California; nests primarily in wetland areas bordering open water Known to nest at Piute Ponds	Low	Low	Moderate	Low	Low	Low	Low	Present
Buteo swainsoni Swainson's hawk	Federal: BCC State: Threatened Local: DRECP	Has been known to breed in the Antelope Valley; nests in large trees or utility poles Not recorded previously at EAFB	Low	Low	Moderate (foraging)	Moderate (foraging)	Moderate (foraging)	Moderate (foraging)	Moderate	High
Charadrius montanus mountain plover	Federal: BCC, BLM Sensitive State: SSC Local: WEMO, DRECP	Edges of ponds and playas Observed near Rogers Dry Lake and other playa/claypan areas of EAFB	Low	Moderate	Low	Low	Moderate	Moderate	Low	Present
Circus cyaneus northern harrier	Federal: None State: None Local: WEMO, DRECP	Forages in a variety of habitats Nests observed at Piute Ponds	Low	Low	Low	Low	Moderate (foraging)	Moderate (foraging)	Moderate (foraging)	Present

Scientific Name Common Name	Status	Habitat Locations on EAFB	Potential for Occurrence							
			Main Base	Flightline	Community	Radar Hill	North Base	South Base	AFRL	Special Use*
Empidonax traillii willow flycatcher	Federal: BCC, BLM Sensitive State: Endangered Local: WEMO, DRECP	Breeds throughout California; nests in shrubs Observed in trees near Piute Ponds, not known to nest on the base	Low	Low	Low	Low	Low	Low	Low	Present
Falco mexicanus prairie falcon	Federal: BCC State: None Local: WEMO, DRECP	Nests on cliff faces Observed foraging throughout EAFB	Moderate (foraging)	Moderate (foraging)	Moderate (foraging)	Moderate (foraging)	Moderate (foraging)	Moderate (foraging)	Moderate (foraging)	Present (foraging)
Falco peregrinus anatum American peregrine falcon	Federal: BCC State: None Local: WEMO, DRECP	Nests on high cliffs, banks Habitat at Leuhman Ridge and Rosamond Hills, not recorded on EAFB	Moderate (foraging)	Moderate (foraging)	Moderate (foraging)	Moderate (foraging)	Moderate (foraging)	Moderate (foraging)	Moderate (foraging)	High (foraging)
Grus Canadensis tabida greater sandhill crane	Federal: None State: Threatened Local: None	Nests near aquatic habitats Observed at Piute Ponds	Low	Low	Low	Low	Low	Low	Low	Present
Ixobrychus exilis Least bittern	Federal: BCC State: SSC Local: None	Nests near aquatic habitats Observed at Piute Ponds	Low	Low	Low	Low	Low	Low	Low	Present
Lanius ludovicianus loggerhead shrike	Federal: BCC State: SSC Local: WEMO, DRECP	Nests and forages in dense desert shrubs and cactus Observed throughout EAFB	Moderate	Moderate	Moderate	High	High	High	High	Present
Riparia bank swallow	Federal: BCC, BLM Sensitive State: Threatened Local: WEMO, DRECP	Nests on cliff faces and banks, forages in grasslands and open habitats Observed at Piute and Branch Ponds	Low	Low	Moderate	Low	Low	Low	Low	Present
Sterna antillarum browni California least tern	Federal: Endangered State: Endangered Local: WEMO, DRECP	Nests near aquatic habitats Observed at Piute Ponds	Absent	Absent	Low	Absent	Absent	Absent	Absent	Present
Toxostoma lecontei LeConte's thrasher	Federal: BCC State: SSC Local: WEMO, DRECP	Occurs in Joshua tree woodland, Mojave Desert scrub Found near washes throughout EAFB	Moderate	Low	Low	Moderate	Moderate	Moderate	Moderate	Present
Mammals										
Antrozous pallidus pallid bat	Federal: BLM Sensitive State: SSC Local: WEMO, DRECP	Roosts in caves and human developments such as mines and hangars Recorded at EAFB	Moderate	Moderate	Low	Low	Moderate	Moderate	Moderate	Present
Corynorhinus townsendii Townsend's western big-eared bat	Federal: BLM Sensitive State: Candidate Threatened; SSC Local: WEMO, DRECP	Roosts in caves and human developments such as mines and hangars Has not been recorded at EAFB	Moderate	Moderate	Low	Low	Moderate	Moderate	Moderate	High
Eumops perotis californicus western mastiff bat	Federal: BLM Sensitive State: SSC Local: WEMO, DRECP	Roosts in cliffs and rock crevices Has not been recorded at EAFB	Low	Low	Low	Low	Low	Low	Moderate	High
Nyctinomops macrotis big free-tailed bat	Federal: None State: SSC Local: WEMO, DRECP	Roosts in rock crevices and on cliffs Has not been recorded at EAFB	Low	Low	Low	Low	Low	Low	Moderate	High
Onychomys torridus southern grasshopper mouse	Federal: None State: SSC Local: WEMO, DRECP	Alkali desert scrub Found in nocturnal trapping throughout EAFB	Low	Low	Low	Low	Low	Low	Low	Present
Taxidea taxus American badger	Federal: None State: SSC Local: WEMO, DRECP	Open dry habitats with variable soils and rodents for prey Found throughout EAFB	Low	Low	Present	Moderate	Present	Moderate	Present	Present

Scientific Name Common Name	Status	Habitat Locations on EAFB	Potential for Occurrence							
			Main Base	Flightline	Community	Radar Hill	North Base	South Base	AFRL	Special Use*
Xerospermophilus mohavensis Mohave ground squirrel	Federal: None State: Threatened Local: WEMO, DRECP	Most desert habitats with sandy or gravelly soils Found mostly on east side of EAFB and southwest of Rogers Dry Lake	Low	Low	Low	Moderate	Moderate	Moderate	Present	Present
Vulpes macrotis arsipis desert kit fox	Federal: None State: Fur-bearing Local: WEMO, DRECP	Primarily found in arid regions, such as desert scrub, chaparral, and grasslands Found throughout EAFB	Low	Low	Moderate	High	Present	High	Present	Present

Source: Edwards AFB, 2016; CNDDB, 2016, M. Hailstone, personal communication 2017
Notes: *If a species is not listed as present it has not been recorded at the base during the past ten years, rather it's potential to occur was based on those factors listed in this section.
*****The Special Use Planning Area is very large, covering 88.5% of the Base and the potential for occurrence of each species is dependent on the specific vegetation communities, soils, elevation and disturbance levels in the localized area of the proposed activity. Where a species has the potential to occur in specific microhabitats, wetlands, etc., in the Special Use Planning Area, the species has been given the highest potential to occur for the Special Use Planning Area as a whole.
Species Status:
BCC: Listed by USFWS as a bird of conservation concern
BLM Sensitive: Species listed as sensitive by the U.S. Bureau of Land Management
SSC: California state species of special concern
DRECP: species covered in the BLM Desert Renewable Energy Conservation Plan (2016)
WEMO : A species that is covered in the Western Mojave Plan

Sensitive Habitats

Sensitive habitats include those listed by Federal, State, and/or Local planning processes as being of local or regional conservation concern, including:

- Areas of designated critical habitat;
- Desert Wildlife Management Areas (DWMAs) and other Areas of Critical Environmental Concern (ACECs) designated by the BLM;
- Plant communities listed as sensitive by CDFW and other resources agencies;
- Plant communities rare or declining and of concern to agencies or local jurisdictions;
- Significant Ecological Areas (SEA) designated by Los Angeles County;
- Wildlife movement corridors; and
- Wetlands and/or other jurisdictional waters.

The Fremont-Kramer desert tortoise critical habitat unit (a USFWS designation) is also designated by the BLM as an ACEC and DWMA. This area is designated for the protection of the Federally- and State-threatened desert tortoise and overlaps portions of the eastern area of Edwards AFB (Figure 3-4). The portion of the Fremont-Kramer area on Edwards AFB covers approximately 65,500 acres primarily located on the AFRL and in the Special Use Planning District.

CDFW tracks communities it believes to be of conservation concern through its List of California Terrestrial Natural Communities (California Department of Fish and Game, 2003) and the California Natural Diversity Database (CNDDB). Sensitive natural communities that occur on Edwards AFB include Joshua tree woodlands, also of local concern. CDFW considers Joshua tree woodlands globally “uncommon, but not rare” and a “high priority for inventory” (California Department of Fish and Game, 2003). This habitat is also specifically designated in many local plans, ordinances, and policies as a biological resource of concern. The Mojave Desert region contains approximately 3,646 square miles of Joshua tree woodland, with approximately 52,728 acres on Edwards AFB (2.3%), the majority within the Special Use Planning District.

The Antelope Valley SEA covers all of the Los Angeles County portion of the installation, within the Special Use Planning District.

Wildlife corridors are defined as linear landscape elements that serve as linkages between historically connected habitats/natural areas, and facilitate movement between these natural areas (Beier and Loe, 1992). Regional documents describing potential linkages show no remaining significant potential linkages in the project region, particularly for the Federally and State threatened desert tortoise (Hagerty, 2010; SC Wildlands, 2012; USFWS, 2013; Vandergast, 2013). Edwards AFB is within the Pacific Flyway for avian migratory species, with potential for numerous migratory species stopping over for food or shelter resources during migrations.

Numerous ephemeral drainages are present throughout Edwards AFB and all Planning Districts. These drainages would be considered isolated and not under the jurisdiction of U.S. Army Corps of Engineers, consistent with other similar drainages within the Antelope Valley Watershed such as those found not to be jurisdictional, under the approved jurisdictional determination issued for the Sunlight Partners Solar Array Project on June 7, 2013 (USACE, 2013). These drainages would likely meet the requirements of waters that would fall under the jurisdiction of CDFW and the Regional Water Quality Control Board (RWQCB) because these drainages are consistent with others in the larger region that have been regulated by these agencies.

3.8 NOISE

3.8.1 Overview

The major sources of noise at Edwards AFB are vehicle traffic on streets from staff, contractors, and vendors traveling to and from Edwards AFB and aircraft operations, including air traffic and engine testing. Motor vehicle noise at Edwards AFB originates mainly at Lancaster Boulevard, Rosamond Boulevard, and primary and secondary streets on Edwards AFB.

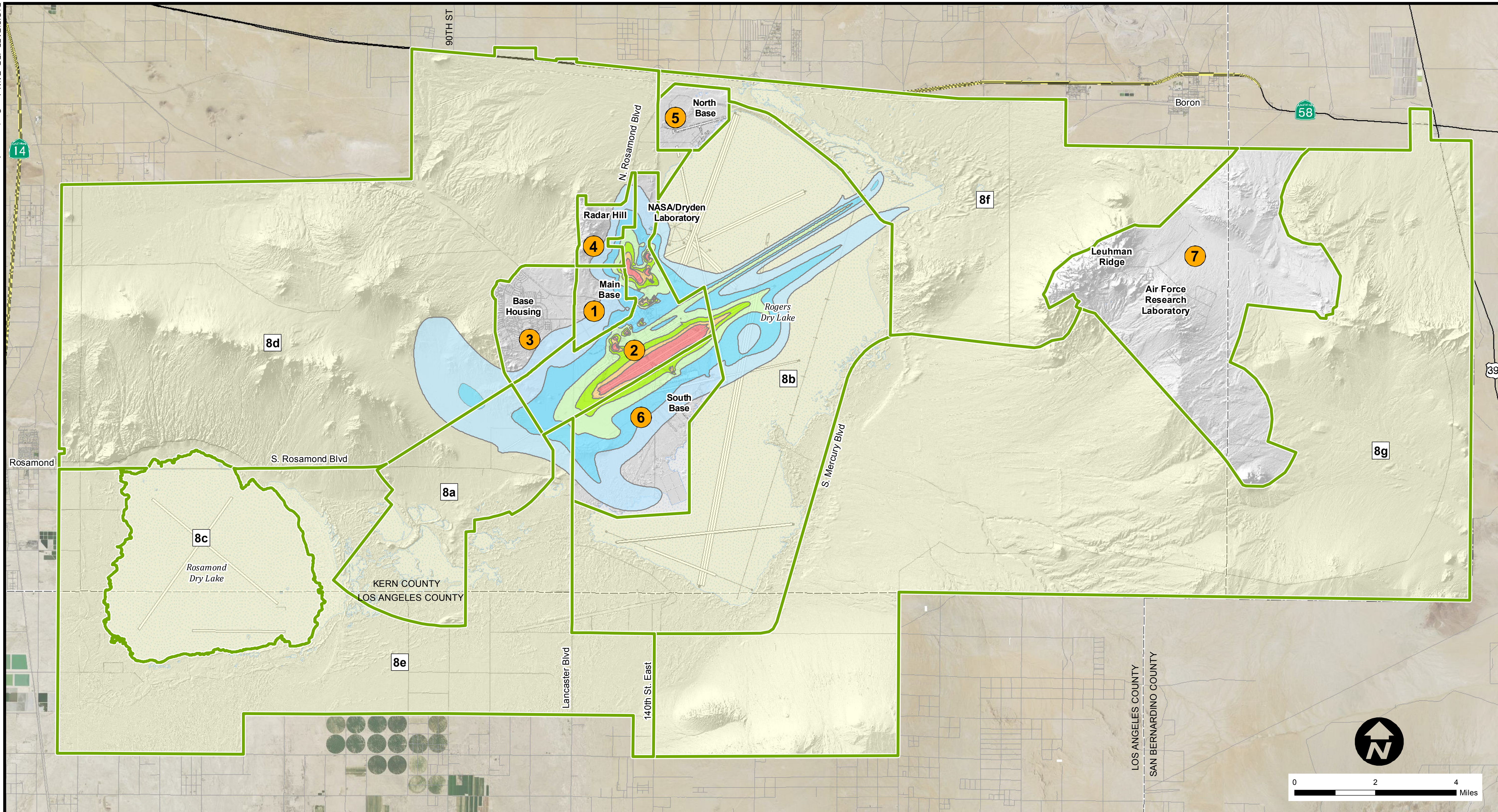
The methodology for describing the statistical characteristics of community noise-level fluctuations is the percent of exceedance. For example, if the noise level during a certain time period exceeds 65 decibels on the A-weighted scale (dBA) for 25 percent of the time (e.g., 15 minutes out of 1 hour), the exceedance for 65 dBA is said to be 25 percent. Noise exceedance levels are denoted by L_{10}, L_{50}, L_{90}, and so on, where the subscript represents the percent of the time that the noise level is exceeded. Additionally, environmental noise can be characterized by average levels such as the energy equivalent continuous noise levels (L_{eq}), which can be averaged over a 24-hour period or, for specific applications, it can be averaged over a portion of the day. The daytime noise level (L_d) refers to noise between 7 a.m. and 7 p.m. The day/night equivalent A-weighted noise level (L_{dn} or DNL) incorporates a 10-decibel (dB) penalty for nighttime noise between 10 p.m. and 7 a.m. to reflect the added likelihood of annoyance during this period. DNL is the standard Federal metric for determining cumulative exposure of individuals to noise. DNL is the 24-hour average A-weighted dB sound level measure of noise.

The Community Noise Equivalent Level (CNEL) has been adopted by the state of California as the descriptor for measuring noise levels. The state recommends 60 CNEL as an acceptable level of exterior noise for residential uses, and the AFI for Air Installation Compatible Use Zone (AICUZ) directs installations in California to show those contours on their AICUZ maps. The decibel is the commonly accepted unit used to measure sound. The CNEL represents the average sound level during a 24-hour day with the addition of a 5 dB penalty for evening noise (7:00 p.m. to 10:00 p.m.) and a 10 dB penalty for nighttime noise (10:00 p.m. to 7:00 a.m.). An aircraft noise study conducted in February 2010 for Edwards AFB to provide detailed analysis of potential noise effects related to current and projected base operations showed a CNEL range of 60 dB to 85 dB. The noise sources included in the study were airfield flight operations, range air

operations by aircraft, range land-based operations, supersonic air operations, and single event sonic booms. The study produced a noise map for Edwards AFB showing that all noise contours, CNEL 60 dB to CNEL 85dB, are contained within the Edwards AFB Base boundaries (Edwards AFB, 2013).

Air Installation Compatible Use Zone

Edwards AFB is exempt from the AICUZ program because its noise contours do not extend beyond installation boundaries (Edwards AFB, 2015; IDP Page 6-12). An aircraft noise study was conducted in February 2010 to provide detailed analysis of potential noise effects related to airfield flight operations, range air operations by aircraft, range land-based operations, supersonic air operations, and single event sonic booms. The study produced a noise map for Edwards AFB that clearly shows that all noise contours, CNEL 60 decibels (dB) to CNEL 85 dB, are contained within the base boundaries (Figure 3-5). Because of this, the installation is exempt from the AICUZ program requirement to prepare, release, and maintain an AICUZ study for its active runways and has a waiver from AFMC to that effect.



Planning District

Special Use Planning District

EAFB Installation Boundary

DECIBEL LEVEL (Mean)

60, 65, 70, 75, 80, 85

PLANNING DISTRICTS

1. Main Base Planning District
2. Flightline Planning District
3. Community Planning District
4. Radar Hill Planning District
5. North Base Planning District
6. South Base Planning District
7. AFRL Planning District

SPECIAL USE PLANNING DISTRICT

- 8a Military Training Planning Sub-district
- 8b Rogers Dry Lakebed Planning Sub-district
- 8c Rosamond Dry Lakebed Planning Sub-district
- 8d Testing & Evaluation North Planning Sub-district
- 8e Testing & Evaluation South Planning Sub-district
- 8f Rich Road Planning Sub-district
- 8g PIRA Planning Sub-district

EDWARDS AIR FORCE BASE

Figure 3-5

2016 Noise Contours

3.8.2 Noise Setting for Each Planning District

Most noise at Edwards AFB is generated by aircraft, with loudest occurrences primarily in the Flightline and South Base Planning Districts. Overflights also generate noise throughout the installation although at a lesser level. Traffic noise occurs along all major roadways, particularly at peak traffic times in the morning and late afternoon, with most traffic in the Main Base and Flightline Planning District. However, with the large size and remote nature of Edwards AFB, most traffic-related noise is not significant. Sensitive receptors, including residences and schools, are located in the Community Planning District, away from the busier Flightline, Main Base, and South Base Planning Districts.

3.9 SOCIOECONOMICS

This section provides an overview of existing socioeconomic conditions in the area, including employment and income. The project study area includes Kern County, Los Angeles County, San Bernardino County, as well as local communities. Impacts from changes in base populations (and therefore, housing and education) have previously been assessed in the 2014 EA for the *Routine and Recurring Realignment of Units and Personnel at Edwards Air Force Base, California* (Edwards AFB, 2014). The scope of this section is limited to an analysis of economic conditions at Edwards AFB.

3.9.1 Overview

Location

As previously discussed, portions of the installation are within three California counties. The majority of the installation is in Kern County, with smaller portions located in Los Angeles and San Bernardino Counties. Local communities in the vicinity of the installation include Boron, California City, Lancaster, Mojave, North Edwards, Palmdale, and Rosamond.

Socioeconomic Resources

Socioeconomic resources are the economic, demographic, and social assets of a community. Key elements include fiscal growth, population, labor force and employment, housing stock and demand, and school enrollment.

Population

Population within the three counties varies. Population estimates for the three counties and the State of California are summarized in Table 3-10.

Table 3-10
Study Area Population Estimates (2010-2015)

Location	2010 Population	2015 Population	Percent Change 2010-2015
Kern County	839,631	882,176	5.07%
Los Angeles County	9,818,605	10,170,292	3.58%
San Bernardino County	2,035,210	2,128,133	4.57%
California	37,253,956	39,144,818	5.08%

Source: US Census Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2015.

Income and Unemployment

A summary of income and unemployment statistics for the three counties and the State of California are presented in Table 3-11.

Table 3-11
Study Area Income and Unemployment

Location	Per Capita Income 2014	Median Household Income 2014	Unemployment 2015
Kern	$20,467	$48,574	10.2%
Los Angeles	$27,987	$55,870	6.7%
San Bernardino	$21,384	$54,100	6.5%
California	$29,906	$61,489	6.2%

Source: American Community Survey 5-Year estimates 2010-2014 (DP03); US Bureau of Labor Statistics, Unemployment rates by state and unemployment by county 2015: http://www.bls.gov/lau/lastrk15.htm

Employment

Edwards AFB employs 2,207 Active Duty Military, 37 Air Reserve/National Guard, and 7,109 Civilian personnel, 2,104 military family members. In total, there were 11,457 personnel including dependents at Edwards AFB in FY 2015 (Edwards AFB, 2015b). An additional 2,800 contractors are employed at Edwards AFB.

Edwards AFB makes a substantial contribution to the economic status of the surrounding communities within the Antelope Valley. The primary area of economic influence is a 75-mile radius surrounding the base, and is comprised of those communities that house the majority of Edward's employees. Edwards AFB had an economic impact on the local area estimated at $1.61 billion in FY 2015. The base's annual payroll was approximately $667 million, its expenditures totaled approximately $373 million, and it added approximately 10,580 indirect jobs to the area, valued at approximately $570 million per year (Edwards AFB, 2015b).

Housing

Privatized housing is located west of the Main Base. Military family housing is owned by Corvias Military Housing, which is responsible for maintaining, repairing, constructing, and managing the community for approximately the next 50 years. The privatized housing inventory consists of 741 homes; 581 homes are intended for enlisted members, and 160 for officers. Distributed throughout seven distinct neighborhoods, Edwards AFB homes have a 99 percent occupancy rate and a waiting list of over 100 families (Edwards AFB, 2015b; IDP page 7-20). Housing is also available in the surrounding communities, including Lancaster, Palmdale, California City, and Tehachapi.

3.9.2 Socioeconomic Setting for each Planning District

The regional socioeconomic setting is applicable to all Planning Districts. Most housing is in the Community Planning District. Jobs are in each Planning District but are primarily in the Main Base, Flightline and South Base Planning Districts.

3.10 WATER RESOURCES

3.10.1 Overview

Edwards AFB is located in the Antelope Valley, which is a basin that is essentially closed with respect to both surface drainage and groundwater movement. Most of the precipitation of the region falls in higher elevations and any resulting storm water flow in ephemeral intermittent streambeds evaporates or infiltrates before it reaches lower elevations. There are no perennial streams on or near Edwards AFB. In an Approved Jurisdictional Determination dated 07 June 2013, the U.S. Army Corps of Engineers (USACE) indicated that there are no navigable waters of the U.S. and no waters of the U.S. within Clean Water Act jurisdiction within the Antelope Valley watershed (with the exception of Lake Palmdale and the Palmdale Ditch and all water tributaries to Lake Palmdale). Edwards AFB is located within the Antelope Valley watershed and, therefore, is not subject to USACE jurisdiction as it contains no waters of the U.S.

Playa Lakebeds. Edwards AFB has permanent playa lake beds that are dry except during rainy seasons (Figure 3-6). The lakebeds and normally dry stream channels are subject to significant flooding after heavy, seasonal storms. The Antelope Valley, where Edwards AFB is located, is an approximate 2,400-square mile drainage basin in which storm water runoff is directed towards Rogers Dry Lake, Rosamond Dry Lake and Buckhorn Dry Lake. Any water that reaches these lakebeds remains until it evaporates.

Surface Water. The Antelope Valley drainage area is bounded by the San Gabriel and Tehachapi Mountain ranges. Major streams that drain this area include: Big Rock Wash, Little Rock Creek, Oak Creek, Cottonwood Creek, Porter Ridge-Amargosa Creek-Palmdale Ditch (Figure 3-6). Drainage from developed areas at Edwards AFB generally flow towards a particular dry lake as follows:

- North Base: southeast into Rogers Dry Lake
- Eastern Main Base: east into Rogers Dry Lake
- Western Main Base: south and east into Rogers Dry Lake
- South Base: north into Rogers Dry Lake
- AFRL: west into Rogers Dry Lake

Flooding hazards at Edwards AFB have been determined by the Federal Emergency Management Agency (FEMA 2016) and are presented on Figure 3-7 (Edwards AFB, 2012b). The category of flood hazards is defined by the as follows (Federal Emergency Management Agency, 2016):

- **Zone A** An area inundated by 1% annual chance flooding, for which no Base Flood Elevations (BFEs) have been determined
- **Zone AE** An area inundated by 1% annual chance flooding, for which BFEs have been determined
- **Zone AH** An area inundated by 1% annual chance flooding (usually an area of ponding) for which BFEs have been determined; flood depths range from 1 to 3 feet
- **Zone AO** An area inundated by 1% annual chance flooding (usually sheet flow on sloping terrain), for which average depths have been determined; flood depths range from 1 to 3 feet
- **Zone D** An area of undetermined but possible flood hazards
- **Zone X** Areas determined to be outside 500-year floodplain determined to be outside the 1% and 0.2% annual chance floodplains

Other flood hazards studies have been conducted at Edwards AFB that have determined that the most critical flood prone areas are associated with Rogers Dry Lake and Rosamond Dry Lake. Flooding hazards associated with Mojave Creek, an ephemeral stream that originates from the Bissel Hills area in the northwest portion of the installation (Dinehart and Harmon 1998), has the potential for impacting portions of the Main Base area (Figure 3-7).

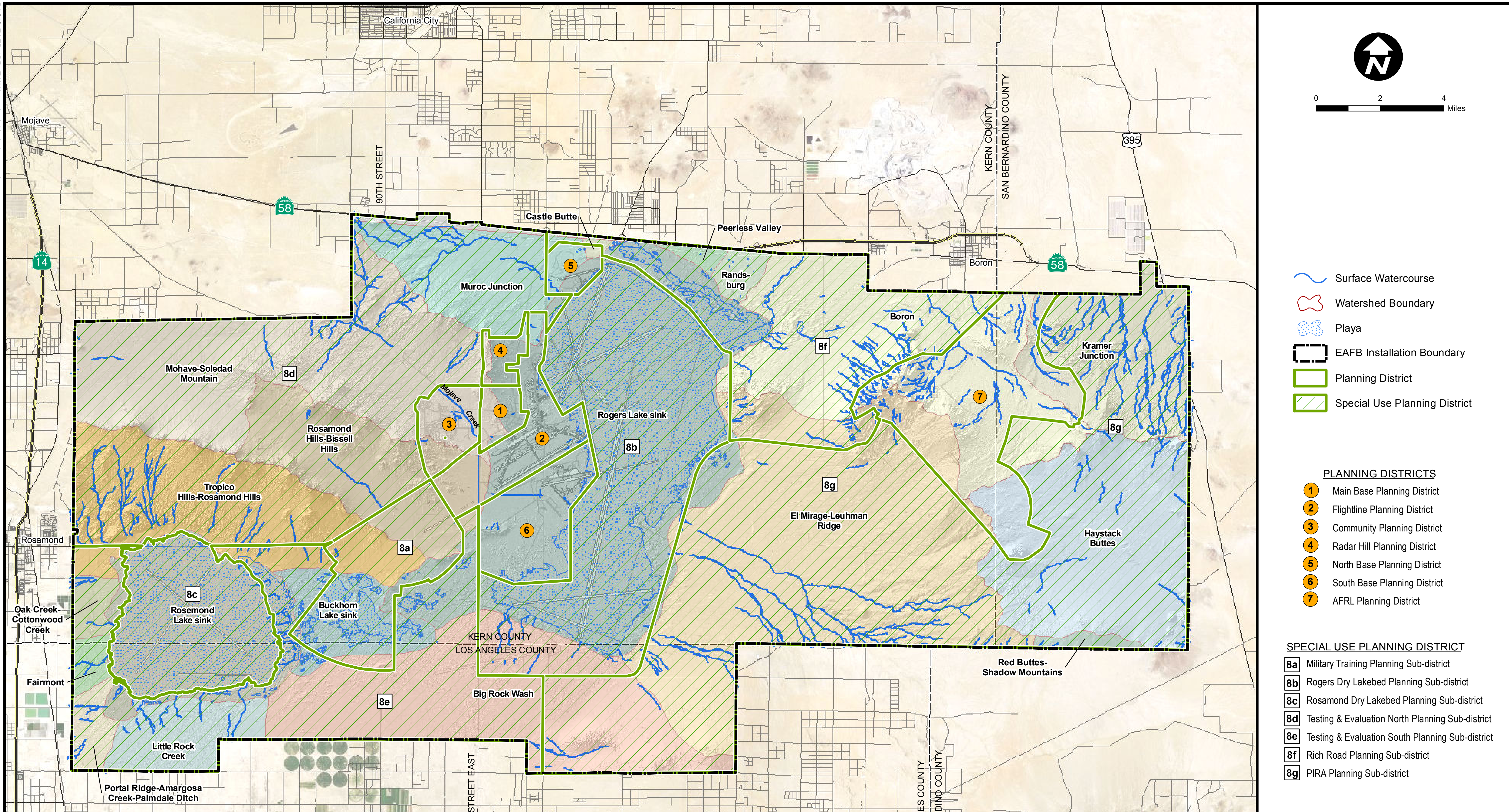
Groundwater. Edwards AFB overlies portions of the following groundwater basins that are part of the South Lahontan Hydrologic Region:

- Antelope Valley Groundwater Basin (No. 6-44)
- Fremont Valley Groundwater Basin (No. 6-46)
- Harper Valley Groundwater Basin (No. 6-47)
- Middle Mojave River Valley Groundwater Basin (No. 6-41) (California Department of Water Resources 2004)

Within the boundary of the Antelope Valley Groundwater Basin, Edwards AFB overlies the Lancaster and North Muroc Sub-basins and within the boundary of the Fremont Valley Groundwater Basin, Edwards AFB overlies the Gloster Sub-basin.

In addition to these sub-basins, Edwards AFB also encompasses areas of bedrock outcrops and shallow bedrock in the Rosamond and Bissell Hills (west and northwest part of the Base), the Hi Vista Area (south central and southeast part of the Base), and Leuhman Ridge in the area of the AFRL.

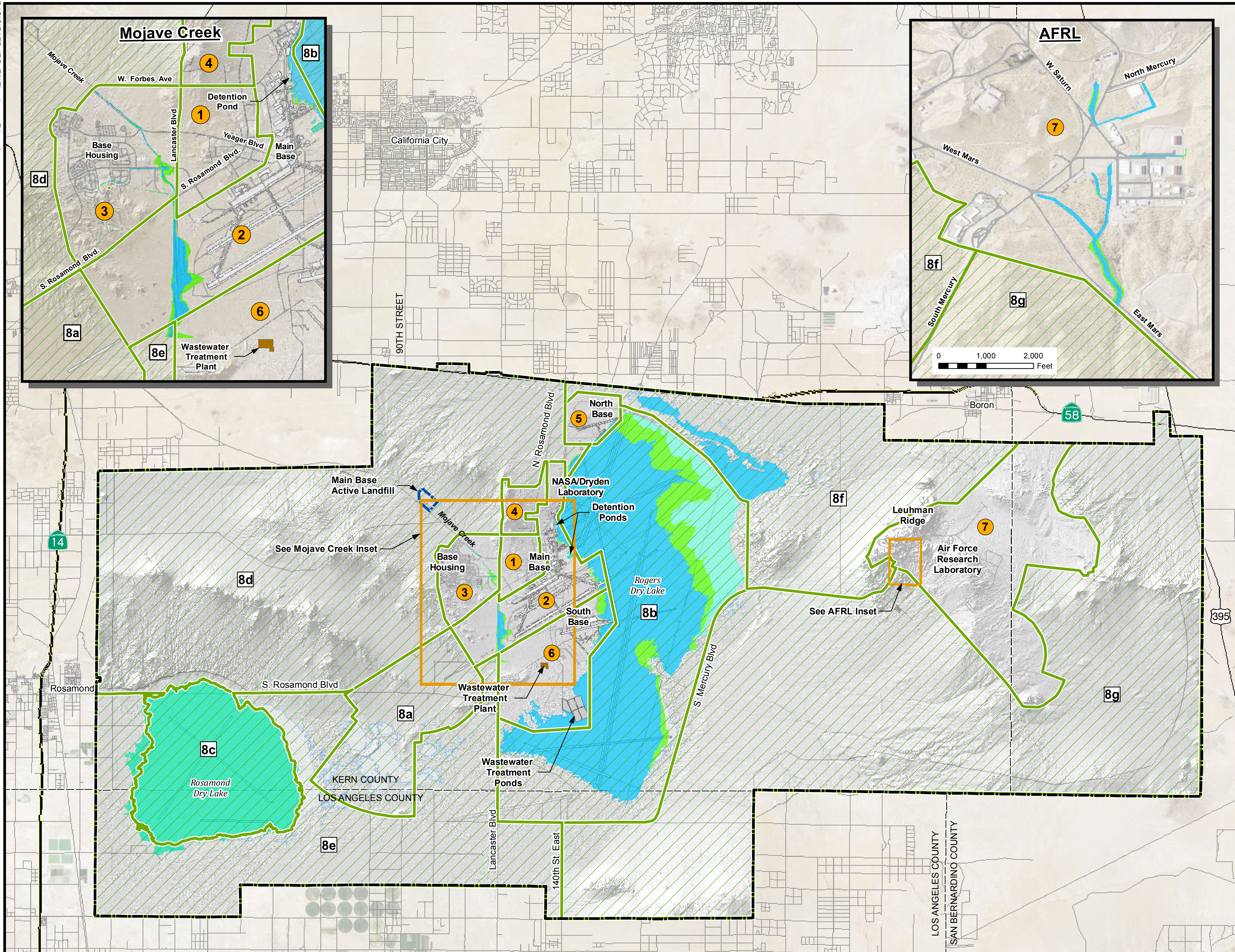
Groundwater at Edwards AFB occurs mainly in unconsolidated alluvial deposits in these groundwater basins and sub-basins. In the Lancaster Sub-basin, the unconsolidated alluvial deposits are known to exceed thicknesses of 1,500 feet. Depth to groundwater used for beneficial purposes from water supply wells on-Base is generally between 100 feet and 125 feet below ground surface (bgs).



EDWARDS AIR FORCE BASE

Figure 3-6

Watershed Hydrology



0 2 4 Miles

FEMA Zone AE
Base flood elevations determined

FEMA Zone AO
Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding velocities are determined

FEMA Zone X
Area determined to be outside to 0.2% annual chance floodplain.

FEMA Zone D
Area in which flood hazards are undetermined, but possible.

Planning District

Special Use Planning District

Landfill Boundary

EAFB Installation Boundary

PLANNING DISTRICTS

1 Main Base Planning District
2 Flightline Planning District
3 Community Planning District
4 Radar Hill Planning District
5 North Base Planning District
6 South Base Planning District
7 AFRL Planning District

SPECIAL USE PLANNING DISTRICT

8a Military Training Planning Sub-district
8b Rogers Dry Lakebed Planning Sub-district
8c Rosamond Dry Lakebed Planning Sub-district
8d Testing & Evaluation North Planning Sub-district
8e Testing & Evaluation South Planning Sub-district
8f Rich Road Planning Sub-district
8g PIRA Planning Sub-district

Note:
The delineated FEMA flood zones in this map are based on location specific studies of Rogers Dry Lake, Rosamond Dry Lake, Rich Dry Lake, Air Force Research Laboratory (AFRL), and the Mojave Creek watershed south of Forbes Avenue. The lack of FEMA flood zone delineation anywhere else on base does not imply that a FEMA flood zone does not exist, but rather that the area has not been subject to a FEMA flood zone analysis.

EDWARDS AIR FORCE BASE

Figure 3-7

Floodplains at Edwards Air Force Base

3.10.2 Water Resources Within or Near Each Planning District

The watershed, drainage and floodplain areas of the installation are shown in Figure 3-6 and Figure 3-7.

Main Base Planning District

Watershed: The Rogers Lake Sink watershed is associated with the Main Base Planning District.

Surface Water: No natural drainages are found in this planning district and no flooding hazards have been identified.

Flightline Planning District

Watershed: The Rogers Lake Sink watershed is associated with the Flightline Planning District.

Surface Water: No natural drainages are found in this planning district. Flooding hazards have been identified for this district on the western border along Lancaster Boulevard. This area has been identified within the 100-year flood zone where base flood elevations have been determined. In addition, Rogers Dry Lakebed found immediately to the east of this district has been identified as a 100-year flood zone where base flood elevations have been determined.

Community Planning District

Watershed: The Rogers Lake Sink watershed is associated with the Community Planning District.

Surface Water. Portions of the Community Planning district are prone to flooding. Areas around Yeager Boulevard and Lancaster Boulevard are within mapped 100-year flood zones where base flood elevations have been determined. Facilities in this area are potentially subject to flooding hazards. Portions of this area are also mapped within the 500-year flood plain.

Radar Hill Planning District

Groundwater: Portions of the Muroc Junction and Mohave-Soledad Mountain watersheds are associated Radar Hill Planning District. The Rogers Lake Sink is the primary watershed associated with this district.

Surface Water. No natural drainages are found in this planning district and no flooding hazards have been identified.

North Base Planning District

Groundwater: The Rogers Lake Sink and Muroc Junction watersheds are associated with the North Planning District.

Surface Water: While natural drainages are found in this planning district outside developed areas. No flooding hazards have been identified along the southwestern edge of this planning district. Minor areas of this district are mapped within the 100-year flood zone where base flood elevations have been determined.

South Base Planning District

Groundwater: The Rogers Lake Sink watershed is associated with the South Planning District.

Surface Water: Natural and channelized drainages are found in this planning district outside and within developed areas, respectively. Flooding hazards have been identified for Rogers Dry Lake that is found immediately to the east of this district. Portions of this district are found within the 500-year and 100-year flood plain. For the 100-year flood plain associated with this district, base flood elevations have been determined.

AFRL Planning District

Groundwater: The following watersheds are associated with the AFRL Planning District.

- Boron
- El Mirage-Leuhman Ridge
- Haystack Butte
- Kramer Junction

Surface Water: Natural drainages are found in this planning district outside developed areas. Flooding hazards have been associated with an unnamed drainage north of E. Mars Boulevard and southeast of N. Mercury Boulevard. Flooding hazards have also been associated with an unnamed drainage on the northern side of W. Saturn, south of North Mercury.

Special Use Planning District

Groundwater: The Special Use Planning Area has a number of watersheds associated with it and are summarized as follows.

- Mohave-Soledad Mountain
- Rosamond Hills-Bissel Hills
- Tropico Hills-Rosamond Hills
- Rosamond Lake Sink
- Buckhorn Lake Sink
- Little Rock Creek
- Big Rock Creek
- El Mirage-Leuhman Ridge
- Haystack Butte
- Kramer Junction
- Born
- Randsburg
- Rogers Dry Lake
- Muroc Junction

Surface Water. As most of this planning area is undeveloped, natural drainages dominate the landscape. These drainages have the potential to convey seasonal stormwater flow. Flooding hazards have been identified for Rogers Dry Lake and Rosamond Dry Lake.

4.0 ENVIRONMENTAL CONSEQUENCES

This chapter presents the potential environmental consequences that could result from implementation of the three alternatives: Alternative 1 – High-Intensity Development, Alternative 2 – Basic Maintenance, and Alternative 3 – No Action. Possible changes to the natural and human environment that could result from the project alternatives were evaluated relative to existing environmental conditions described within Chapter 3.0. Mitigation measures are presented that would mitigate potentially significant adverse impacts to a level that is not significant. This chapter also provides a discussion of cumulative impacts, unavoidable adverse effects, short-term uses versus long-term productivity of the environment, and the irreversible and irretrievable commitment of resources.

4.1 AIR QUALITY AND GREENHOUSE GASSES

Emissions resulting from the construction associated with implementation of the IDP would originate primarily within Kern County, but emissions resulting from construction within the AFRL Planning District could also potentially originate within San Bernardino County. Emissions resulting from construction within the Special Use Planning District could potentially originate within Kern County, San Bernardino County or Los Angeles County. The Kern County portion of the installation is under the jurisdiction of the EKAPCD. The Los Angeles County portion of the installation is under the jurisdiction of the AVAQMD. The San Bernardino County portion of the installation is under the jurisdiction of the MDAQMD. Each of these air districts has set thresholds of significance for criteria pollutants and GHGs which must not be exceeded in order to ensure that project emissions are consistent with air quality management plans and GHG goals.

The air and GHG emissions resulting from the implementation of the IDP would be mostly short-term construction emissions, which are temporary emissions generated during the construction of a project. Short-term emissions are typically generated by on-road (e.g., employee vehicles and vendor/delivery trucks) and off-road vehicles or equipment (e.g., backhoes, bulldozers, portable generators, and cranes), as well as dust generation due to clearing, grading, excavating, and trenching activities. For building construction, emissions are

also generated from architectural coatings. Short-term emissions end once the construction phase is completed.

Long-term or operational emissions would be expected to occur as a result of operations conducted at the new facilities including but not limited to employee vehicle trips, use of utilities (e.g., electricity, drinking water, and wastewater), and maintenance activities associated with buildings, roads, and parking lots.

4.1.1 Methodology

For any of the alternatives, one or more projects at a time may be conducted in one or more Planning Districts. Because Alternative 1, the High-Intensity Development Alternative, could result in the highest level of development and, therefore, would result in the most air emissions, it was used as the worst-case scenario. Emissions from the other two alternatives would be substantially less.

To calculate emissions resulting from projects that could be part of Alternative 1, the total of each development type (e.g., demolition and construction of facilities, aircraft parking, sidewalks, and bike trails) for all Planning Districts listed in Table 2-1 (Alternative 1 projects) was divided by ten, and the results were used as input parameters for the emissions modeling. This approach is based on the premise that all projects would be completed over a 10-year period (i.e., short-range projects conducted in the first through fifth years, and medium range projects in the sixth through tenth years). Dividing the total development by 10 provides an average of annual project construction. This is a level of construction that exceeds the two to three major projects per year that have been typical at Edwards AFB over the past 10 years. Therefore, this methodology provides a reasonable worst-case scenario from which to evaluate the significance of emissions.

Emissions calculations were modeled using general office building and parking lot structure land uses. The general office building land use is representative of a building housing multiple tenants where affairs of commercial or industrial businesses are conducted by organizations, professional persons or firms. The parking structure land use is reflective of parking lots, ramps, aprons, sidewalks and bike paths.

Construction (or short-term) emissions would result primarily from activities including land clearing, demolition, and construction of structures (e.g., buildings, parking lots, and flightline runway sections and ramps). Long-term emissions would be generated during the operations of the proposed project. Emissions in this EA were calculated using California Emissions Estimator Model (CalEEMod), which provides a platform for calculating emissions from a land use project. CalEEMod is designed to calculate both daily and annual emissions of criteria pollutants and GHGs. It also features built-in default values that can be used to calculate construction and operation emissions. Default values (e.g., equipment usage, construction phase lengths, architectural coating areas, vehicle fleet mix, and energy use) are based on surveys conducted by the South Coast Air Quality Management District (SCAQMD) and emission factors established by various organizations including the USEPA, CARB and the SCAQMD.

CalEEMod allows for the use of various mitigation measures when calculating criteria pollutant emissions. For the proposed project, mitigation measures used in CalEEMod, which are expected to be implemented in this project, consists of use construction equipment with Tier 2 engines, watering exposed areas twice each day, improving pedestrian network (e.g., construction of sidewalks and walking trails), implementation of 9/80 work schedule, use of low VOC cleaning supplies, installation of low flow fixtures, and use of water efficient irrigation systems.

Calculated emissions and assumptions used in the calculations are included in Appendix C. Emissions are summarized in Table 4-1.

4.1.2 Significance Criteria

Emissions would be considered significant if they would:

- Violate any ambient air quality standard or contribute substantially to an existing or projected air quality violation
- Exceed local or federal significance thresholds for criteria pollutants
- Exceed *de minimis* thresholds to determine whether or not a conformity analysis is required
- Expose sensitive receptors, such as schools, hospitals or residential areas to substantial pollutant concentrations

4.1.3 Impacts Analysis

4.1.3.1 Alternative 1 – High Intensity Development

Alternative 1 has the largest estimated project area, with estimated project development types and sizes identified in Table 2-1. Since the largest amount of emissions generated would result from Alternative 1, it represents the worst case scenario and emissions were calculated only for this alternative. For the purposes of air analysis, emissions were calculated only for one of the 10 years during which the Proposed Action's projects are expected to be executed. Construction equipment specifics (e.g., type, hours of operation, horse power, and length of use) and on road vehicles (e.g., construction crew and vendor vehicles) miles traveled used in the calculation of emissions are CalEEMod default values and listed in Appendix C. Operational emissions are expected as a result of operations conducted at each new facility or facility expansion, and resulting emissions were also calculated using CalEEMod.

Calculated construction and operational emissions are compared against *de minimis* thresholds to determine whether or not conformity determination is required and are compared against significance thresholds to determine whether or not each alternative may have any significant effect in the environment. Table 4-1 provides calculated, mitigated emissions from Alternative 1, thresholds of significance published by each of the air districts affected by the Proposed Action, *de minimis* thresholds for conformity analysis, and significance status. For all pollutants, including dust-related pollutants (PM_{10} and $PM_{2.5}$), implementation of the High Intensity Development Alternative would not exceed significance thresholds or *de minimis* thresholds.

Implementation of Alternative 1 would have less than significant impacts. Emissions of criteria pollutants resulting from potential construction and operations would be below the general conformity *de minimis* thresholds, exempting this Alternative from conformity requirements. Criteria pollutants and GHG emissions would also be below local significance thresholds, thereby resulting in a less than significant impact on the environment.

Table 4-1
Project Air Emissions of Criteria Pollutants and GHGs and Thresholds

Project Phase and Thresholds	CO	VOC	NOx	SO_2	PM_{10}	$PM_{2.5}$	H_2S	Lead	CO2e
Construction Emissions in tpy (lb/day) for 2017	4.2 (40.5)	2.4 (131.3)	4.0 (51.8)	0.0 (0.1)	0.4 (11.0)	0.3 (7.0)	ND (ND)	ND (ND)	574.0 (5,245.3)
Operational Emissions	12.6 (86.6)	2.6 (16.2)	2.7 (18.2)	0.0 (0.1)	1.2 (8.7)	0.3 (2.5)	ND (ND)	ND (ND)	2,476.6 (12,514.4)
[a,b]EKAPCD Significance Thresholds in tpy (lb/day)	None	25 (137)	25 (137)	None	15 (82)	None	None	None	25,000 (136,986)
[c]AVAQMD and [d]MDAQMD Significance Thresholds in tpy (lb/day)	100 (548)	25 (137)	25 (137)	25 (137)	15 (82)	15 (82)	10 (54)	0.6 (3)	100,000 (548,000)
De minimis Thresholds (tpy)	N/A	[1]100/ [2]25	[1]100/ [2]25	N/A	[3]100	N/A	N/A	N/A	N/A
Significant?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**

Source:
a Source for criteria pollutants: County of Kern 2006
b Source for CO2e: EKAPCD 2012
c AVAQMD 2011
d MDAQMD 2011

Notes:
1 *de minimis* threshold for Eastern Kern County
2 *de minimis* threshold for Los Angeles County portion of the AVAQMD
3 *de minimis* threshold for San Bernardino County portion of the MDAQMD

AVAQMD	Antelope Valley Air Quality Management District
CO	carbon monoxide
CO2e	carbon dioxide equivalent
EKAPCD	Eastern Kern Air Pollution Control District
GHG	greenhouse gas
H_2S	hydrogen sulfide
lb/day	pounds per day
MDAQMD	Mojave Desert Air Quality Management District
N/A	not applicable
ND	not determined
NO_x	nitrogen oxides (nitrogen oxide and nitrogen dioxide)
PM2.5	particulate matter less than 2.5 microns in diameter
PM10	particulate matter less than 10 microns in diameter
SO_x	sulfur dioxide
tpy	tons per year
VOC	volatile organic compound

The implementation of Minimization Measures (MM) AIR-1 through AIR-13 would further reduce impacts to a less than significant level.

MM AIR-1: Project activities shall comply with all applicable rules and regulations as identified in AFI 32-7040, *Air Quality Compliance and Resource Management* (2014).

MM AIR-2: The project shall comply with all applicable EKAPCD, MDAQMD or AVAQMD rules and regulations, including but not limited to New Source Review, and obtain any required air quality permits. Emissions from permitted devices and activities must be tracked and reported to the appropriate air district, CARB and the USEPA, as required. Air quality permits, if required, shall be coordinated through the Environmental Management Division at Edwards AFB. The Environmental Management Division is the lead agency for the application and maintenance of air quality permits on Edwards AFB. Very few, if any, air quality permits would be required for this project as the majority of emissions will be due to mobile sources.

MM AIR-3: Any non-mobile internal combustion engine, greater than 50 brake horsepower, must be permitted by the local AQMD/APCD. The Reciprocating Internal Combustion Engine National Emissions Standards for Hazardous Air Pollutants (RICE NESHAP) or New Source Performance Standards apply to all stationary engines regardless of size. Permitting is also required (retroactively) for any non-road engine that fails the indicia of portability (i.e., exceeds the 12-month time limit). If such equipment is to remain on base less than 45 calendar days, a written exemption must be obtained from the local air agency. The proposed project shall also conform to the USEPA regulations for industrial boilers, commercial and institutional boilers, and process heaters as adopted in 40 CFR Part 63 subparts DDDDD (Major Sources) and JJJJJJ (Area Sources). All major source boilers and process heaters and area boilers are subject to a work practice standard requiring owners to periodically conduct tune-ups of the boiler or process heater. Major stationary source of hazardous air pollutants (HAP's) are those that emit or have the potential to emit 10 tons per year or more of any single air toxic or 25 tons per year or more of any combination of air toxics. Area source facilities are those facilities that are not major stationary sources of HAPs. Boilers affected by the Area Source rule are those boilers that burn coal, oil and other liquid fuel, biomass, and non-waste materials.

MM AIR-4: The proposed project shall not discharge from any source whatsoever, such quantities of air contaminants or other material that would: cause injury, detriment, nuisance or annoyance to any considerable number of persons or to the public; endanger the comfort, repose, health or safety of any such persons or the public; or cause or have a natural tendency to cause injury or damage to business or property.

MM AIR-5: All earthwork activities shall be planned and conducted to minimize the duration that soils would be left unprotected. The extent of the area of disturbance necessary

to accomplish the project shall be minimized. Exposed surfaces shall be periodically sprayed with water.

MM AIR-6: Visible emissions (e.g., dust or smoke) from the proposed projects shall not exceed the limitations as outlined by the local air district.

MM AIR-7: Apply water or dust suppressants to roads and open areas where dust is being generated. If winds produce excessive visible emissions, erect wind barriers. Do not grade or till compacted dirt without applying water or dust suppressant.

MM AIR-8: Discontinue grading and other ground-disturbing activities at wind speeds exceeding 25 mph.

MM AIR-9: All vehicles transporting fill material or debris shall be covered to reduce PM2.5 and PM_{10} emissions during transport.

MM AIR-10: Temporary coverings must be installed over open storage piles.

MM AIR-11: All mechanical and construction equipment shall be kept in good working order according to applicable technical orders and the manufacturer's equipment maintenance manuals to reduce emissions to acceptable levels.

MM AIR-12: The following dust control measures will be implemented during land preparation (i.e., clearing, grading, etc.), excavation and/or post-construction:

- All soil excavated or graded should be sufficiently watered to prevent excessive dust. Watering should occur as needed with complete coverage of disturbed soil areas. Watering should be a minimum of twice daily on unpaved/untreated roads and on disturbed soil areas with active operations.
- All clearing, grading, earth moving and excavation activities should cease during periods of winds greater than 20 mph (averaged over one hour), if disturbed material is easily windblown or when dust plumes of 20% or greater opacity impact public roads, occupied structures or neighboring property.
- All fine material transported off site should be either sufficiently watered or securely covered to prevent excessive dust.
- All haul trucks should be required to exit the site via an access point where a gravel pad or grizzly has been installed.
- Stockpiles of soil or other fine loose material shall be stabilized by watering or other appropriate method to prevent wind-blown fugitive dust.
- Once clearing or grading has ceased, all inactive soil areas within the project area should either be seeded and watered until plant growth is evident, treated with a dust palliative or watered twice daily until soil has sufficiently crusted to prevent fugitive dust emission.
- On-site vehicle speed should be limited to 15 mph.

- All areas with vehicle traffic should be paved, treated with dust palliatives or watered a minimum of twice daily.
- Streets adjacent to the project site should be kept clean and accumulated silt removed.
- Revegetation/restoration shall be required based on the level of disturbance created from project activities. Revegetation/restoration shall be in accordance with the *Edwards Air Force Base Revegetation Plan* (AFFTC/EM 1994).

MM AIR-13: The following measures should be implemented to control construction vehicle tailpipe emissions:

- All on-road and off-road vehicles will comply with the ARB On-Road and Off-Road control measures
- Properly maintain and tune all internal combustion engine powered equipment
- Require employees and subcontractors to comply with the ARB idling restrictions for compression ignition engines
- Use CARB diesel fuel

4.1.3.2 Alternative 2 – Basic Maintenance Alternative

Under Alternative 2, no new structures or facilities would be built. Existing facilities would be maintained and could also be renovated or repurposed. Emissions resulting from this alternative would be negligible and may be less than under current conditions and, therefore, would also be *de minimis*. No adverse impacts would result and no mitigation would be required.

4.1.3.3 Alternative 3 – No Action Alternative

Under the No Action Alternative (Alternative 3), a minimal level of development would continue and future installation development projects would continue to be evaluated on an individual basis without regard to planning district efficiency, current capacity or functionality. No additional construction or operations emissions would be generated beyond current conditions. Impacts would be similar to those for Alternative 1 although to a much lesser extent. MM AIR-1 through MM AIR-13 would ensure that impacts would remain at a less than significant level.

4.2 CULTURAL AND PALEONTOLOGICAL RESOURCES

4.2.1 Methodology

This section addresses resource types or cultural context (e.g., Prehistoric, Historic-period, Sub-modern) that have been identified in the general area, along with those resources deemed eligible under the NRHP, CRHP, or California Historic Landmarks (CHL), or are considered of tribal interest. Impacts on cultural resources (both archeological and architectural resources) and paleontological resources could result from ground-disturbing activities and/or damage, destruction, or alteration of historic structures. Ground-disturbing activities include project-related excavation, grading, trenching, vegetation clearance, the operation of heavy equipment, surface and sub-surface disturbance that could damage or destroy surficial or buried cultural resources including prehistoric or historic period archaeological resources, paleontological resources, or human burials.

4.2.2 Significance Criteria

As noted above, cultural resources (both archeological and architectural resources) constraints are limited to those that have been deemed eligible under the NRHP, CRHP, or CHL, or are considered of tribal interest. Further, the following criteria were used in evaluating the significance of impacts related to the cultural resources and paleontological resources found within the various Planning Districts:

- Archaeological sites are measured in quantity of acres of listed or eligible sites and percent of Edwards AFB’s total area.
- Historic facilities are measured in the number of historic facilities eligible for listing in the NRHP.
- The potential for ground-disturbing activities to encounter subsurface cultural or paleontological resources, which would be damaged or destroyed by the proposed actions. This includes digging, planting, grading, landscaping, construction or installation of sidewalks, trails, paths, structures, installation of fencing, or switching terminals.
- New construction planned in areas that have not been surveyed for cultural (both archeological and architectural resources) or paleontological resources to date, or areas that require updated cultural resources surveys. This includes construction or installation of sidewalks, trails, paths, structures, fencing, or switching terminals.

- The demolition of buildings, structures, or objects over 45 years in age that have not been evaluated as cultural resources.
- The demolition of buildings, structures, or objects over 45 years in age that have been identified as historic properties (eligible for inclusion to the NRHP or CRHP).

4.2.3 Impacts Analysis

The ICRMP (Edwards AFB 2017) provides information regarding previous cultural resources surveys and associated resources for the entire installation. The project is considered to be the eight Planning Districts as the Area of Potential Effect (APE) for the proposed undertaking. Based on past land use activities in the Regional Area and prior cultural resources studies, multiple types of cultural resources (both archeological and architectural resources) have been identified within the Planning Districts.

The results of the prior cultural resources surveys provided an inventory of the archaeological and architectural resources identified within each Planning District, which aided in the assessment of the risk of adverse effects. Previously, a total of 4,657 archaeological sites had been identified throughout Edwards AFB; of these, 3,439 are considered eligible for the NRHP or have not been evaluated to date. Eleven Sacred Sites have been identified by Native American Tribes. To date, approximately 66% of Edwards AFB has been surveyed for archaeological resources. There are a total of 3,234 facilities and structures listed in Edwards AFB Real Property system that are tracked by Cultural Resources. Of that total, 368 have been evaluated and concurred upon using the Secretary of Interior Standards. One is listed on the national register and 152 are either individually eligible or are contributing elements of a historic district.

Table 4-2 provides a summary of the resources identified within each of the Planning Districts. In summary, the Main Base and North Base Planning Districts had the lowest frequency of sites and the least area covered by sites, while the Special Use Planning District had the highest frequency of sites.

Table 4-2
Summary of Cultural Resources Associated with the Planning Districts

Planning District	Developable Acres	Prehistoric Sites	Historic Sites	Total Number of Cultural Resources	Total Historic Structures	% of Planning District Surveyed by Cultural Resources[1]
Main Base	882	5	13	18	0	95
Flightline	157	46	92	138	8	75
Community	1,067	65	209	274	0	55
Radar Hill	474	10	20	30	0	80
North Base	402	20	8	28	51	68
South Base	605	54	131	185	1	80
AFRL	0	62	113	175	90	50
Special Use	0	1,910	1,899	3,809	2	66
Total	**3,587**	**2,172**	**2,485**	**4,657**	**152**	--

[1]Areas previously surveyed may require additional surveys prior to development or land-disturbing activities depending on the age of the survey.

4.2.3.1 Alternative 1 – High-Intensity Development

Under Alternative 1, the general types of projects expected in each Planning District are:

- **Main Base Planning District:** new construction; demolition of existing structures; installation of landscaping, sidewalks, and trails/paths; and the enlargement of remote super remote switching terminals
- **Flightline Planning District:** new construction; demolition of existing structures; installation of landscaping and fencing; and the renovation/maintenance of taxiways, ramps, pads, and aprons
- **Community Planning District:** new construction; demolition of existing structures; installation of landscaping, sidewalks; and the installation of new trails/paths
- **Radar Hill Planning District:** new construction; demolition of existing structures; installation of landscaping and fencing; range expansion and the development of radar sites
- **North Base Planning District:** new construction; demolition of existing structures; installation of landscaping and fencing; expansion of ramps; and the paving and expansion of existing roadways

- **South Base Planning District:** new construction; demolition of existing structures; installation of landscaping and fencing; and the construction of aircraft parking and aprons
- **AFRL Planning District:** new construction; rehabilitation of existing test stands; demolition of existing structures; and installation of fencing
- **Special Use Planning Sub-Districts:** new construction; demolition of existing structures; ECP improvements/expansion; or EUL opportunities (utilities, infrastructure, access roads)

In areas not previously surveyed, a cultural resources survey (to identify both archaeological and architectural resources) should be performed prior to the onset of the construction, demolition, installation, or enlargement. These proposed undertakings may have an adverse effect on known cultural resources within each project footprint. Formal evaluation (e.g., Phase II testing) or data recovery (e.g., Phase III) may be necessary, as warranted. While avoidance is the preferred treatment for cultural resources (both archaeological and architectural resources), avoidance is not always feasible. In such situations, a cultural resources monitor may be present for the duration of the ground disturbance or renovations. However, with incorporation of MM CUL-1, potential impacts to cultural resources would be reduced to a less than significant level.

MM CUL-1: Avoidance is the preferred treatment for NRHP-eligible cultural resources. If avoidance is not possible, then resources will need to be evaluated prior to any development and construction within a proposed Planning District, and any potentially NRHP-eligible resources will require resolution of the adverse effects. Construction monitoring may be implemented in areas where subsurface cultural resources are anticipated. Additional site-specific mitigation may be implemented prior to development in any of the Planning Districts. In addition, any projects developed for a proposed Planning District should be coordinated with Edwards AFB Archaeologist and/or Architectural Historian. This coordination will address resource-specific mitigation, which may be further developed through consultation with the California SHPO or through Native American consultation.

4.2.3.2 Alternative 2 – Basic Maintenance Alternative

Under Alternative 2, no new construction would occur. Rather, this effort would focus on the maintenance, renovation, or repurposing of existing facilities or structures. There may be consolidation of functional areas and personnel. Little to no effect is anticipated with regard to cultural resources (both archaeological and architectural resources) under Alternative 2. No mitigation would be required. Cultural resources (both archaeological and architectural

resources) would continue to be managed through the policies established in the ICRMP (Edwards AFB, 2017).

4.2.3.3 Alternative 3 – No Action Alternative

Under the No Action Alternative, there would be no change in the treatment of the resources; cultural resources (both archaeological and architectural resources) would continue to be managed through the policies established in the ICRMP (Edwards AFB, 2017). Implementation of MM CR-1 would further reduce impacts.

4.3 GEOLOGY AND SOILS

This section describes the geologic hazards and soil resources impacts that would occur with potential development within the various Planning Districts. The analysis evaluates the impacts of construction plus operation and maintenance.

4.3.1 Methodology

The potential impacts related to geologic and seismic hazards were evaluated by assessing if there would be life/safety concerns or impacts from implementation of any of the alternatives. Most impacts related to geology and soils would occur during construction. Seismicity is a concern during construction and operation.

4.3.2 Significance Criteria

The geology and soils resources found within each alternative under analysis includes geological features and soils. Other aspects of these resources include earthquakes, subsidence, unstable slopes and other hazards that may limit siting and affect construction.

The following criteria were used in evaluating the significance of impacts related to the geology and soil resources found at Edwards AFB.

- The degree to which unique or scenic landforms and topographic features would be damaged, destroyed, or rendered inaccessible by construction
- The degree to which the stability of slopes and foundation substrates may be lessened by excavation or grading

- The potential for naturally occurring geological events including subsidence, landslides and mudflows, and rupture and ground shaking during earthquakes, to affect construction and the operation of the selected utility corridor
- The amount of disruption of the ground surface and destruction of the soil profile through excavation and removal of rock and soil in the construction of any alternative selected
- The potential for erosion caused by disturbance of the ground surface during the construction of any alternative selected particularly as a result of exposing construction areas and equipment routes to increased potential for wind or storm water soil loss
- The potential for soil conditions such as corrosivity and swell-shrink that may affect construction and operation of the selected utility corridor

Because there are no Alquist-Priolo Earthquake Fault Zones at Edwards AFB, there would be no impacts under this criterion from any component of the Project and therefore, it is not discussed further.

4.3.3 Impacts Analysis

4.3.3.1 Alternative 1: High Intensity Development Alternative

As discussed in Chapter 2, the IDP lays out long-term, maximum buildout in each Planning District, with Alternative 1 providing a worst-case for the environmental analysis that allows for flexibility in the types and numbers of projects that may be undertaken, a high-intensity development alternative is proposed (Alternative 1). For this alternative, a select list of projects (or types of projects) that are most likely to occur or represent the types of development that could occur in each planning area have been selected for inclusion in the environmental analysis. Table 2-1 provides an overview of the types of developments considered in each Planning District and provides a sum total (where applicable) of each type of development.

Landforms. Construction of projects within the Planning Districts would not damage or destroy existing landforms found within the Planning Districts. Most development would occur in areas adjacent to existing development or in areas previously disturbed. No impacts would occur.

Geology. Any project within any of the Planning Districts has the potential to be impacted by the geology or soils that may become unstable during a seismic event. While there are no known active faults on Edwards AFB, active faults are found within the region. During a seismic event, development in all Planning Districts could be affected. Naturally occurring geological events

including subsidence, landslides and mudflows, and rupture and ground shaking during earthquakes have the potential to affect construction and the operation of projects identified as part of Alternative 1. Impacts would be minimized by implementation of standard construction methods and, where applicable, implementation of MM GEO-1.

Soils. Construction of projects identified in Alternative 1 have a high potential for soil loss due to wind erosion for all planning districts at Edwards AFB. Once construction is complete, potential loss of soil due to wind or storm water erosion would not likely exceed current developed conditions found throughout much of Edwards AFB. Impacts would be less than significant with implementation of MM GEO-2 through MM GEO-5.

The following MMs would reduce potential project impacts from a naturally-occurring seismic event and potential wind or storm water erosion of soils. Not all of these measures will be applicable to all projects. Each project will need to be evaluated to determine which is appropriate.

MM GEO 1: Prior to final project design, a geotechnical study should be conducted by a qualified geologist/engineer to identify site-specific geologic conditions and potential geologic hazards in sufficient detail to support sound engineering. Appropriate mitigations for identified geological hazards would be identified in the geotechnical study.

MM GEO-2: Prepare and implement a construction Storm Water Pollution Prevention Plan (SWPPP) prior to the commencement of soil disturbance activities associated with construction.

MM GEO-3: Use non-hazardous dust suppression palliatives approved by Edwards AFB and water on an as-needed basis to suppress wind-blown dust generated at the site during construction. Dust suppression palliatives are materials that work by either agglomerating the fine particles, adhering/binding the surface particles together, or increasing the density of the surface material.

MM GEO-4: Implement erosion control measures during construction, including stabilization of construction areas, employing a concrete wash out area, as needed, and tire washes near the entrance to existing roadways.

MM GEO-5: Install silt fences for erosion control during construction.

4.3.3.2 Alternative 2: Basic Maintenance Alternative

With Alternative 2, no new structures or facilities would be built. It would consist of maintaining existing facilities so that they are kept operational to prevent mission degradation. This could include renovation or repurposing of existing structures to configure facilities to meet ever changing missions and further enhance planning district efficiency. It may also include consolidation of functional areas and moving people around according to function or organization. As a result, renovation or repurposing of existing facilities within the Planning Districts would not damage or destroy existing landforms, nor would any new impacts related to seismicity or soil erosion occur. No adverse impacts would occur and, therefore, no mitigations are proposed.

4.3.3.3 Alternative 3: No Action Alternative

The No Action Alternative would be no change from current practices. On average, over the past 10 years, approximately 2 to 3 major projects have been constructed at Edwards AFB each year. Under the No Action Alternative, this minimal level of development would continue and future installation development projects would continue to be evaluated on an individual basis. Impacts would be similar to those for Alternative 1 although to a much lesser extent. Implementation of MM GEO-1 through MM GEO-5 would ensure that impacts would remain at a less than significant level.

4.4 HAZARDOUS MATERIALS AND HAZARDOUS WASTE

This section describes the potential hazardous materials and hazardous waste impacts that could occur with implementation of each of the project alternatives.

4.4.1 Methodology

The degree to which proposed implementation of any of the project alternatives could affect the existing environmental management practices was considered in evaluating potential impacts to and from hazardous materials and wastes, including ERP sites.

4.4.2 Significance Criteria

Significant impacts could result if:

- Nonhazardous/regulated and hazardous substances were collected, stored and/or disposed of improperly
- Any changes were needed to manage hazardous materials or waste

4.4.3 Impacts Analysis

4.4.3.1 Alternative 1: High Intensity Development Alternative

Environmental Restoration Program. Construction and operation of projects associated with Alternative 1 would not mobilize existing contaminants associated with identified OUs at Edwards AFB in groundwater or soil, or expose workers to contaminated soils or groundwater. In the unlikely event that contaminated soil or groundwater were encountered during development activities, appropriate measures in accordance with State and Federal regulations would be taken to ensure that human health was protected. With incorporation of MM HAZ-1, potential impacts to hazardous materials and hazardous waste would be reduced to a less than significant level.

Hazardous Materials and Hazardous Waste Management. The use of hazardous materials during development under Alternative 1 is anticipated to be limited to construction vehicle maintenance (fuel, oils, and lubricants) activities and construction materials (adhesives, sealants, etc.). These materials would be required to be properly contained, manifested, and managed in accordance with all Federal, State, and Local regulations, AFIs, and DoD Directives. No long-term change in existing hazardous materials and hazardous waste management would occur as a result of any development under Alternative 1. All Federal, State, and Local environmental laws would continue to be observed, as well as preventative measures contained in the Edwards AFB Hazardous Waste Management Plan (HWMP). As such, no adverse impacts related to hazardous materials and waste would be expected under Alternative 1 and no mitigation is required. With incorporation of MM HAZ-1, potential impacts to hazardous materials and hazardous waste would be reduced to a less than significant level.

MM HAZ-1: Project activities shall comply with all applicable rules and regulations as identified in AFI 32-7086, *Materials Management* (2015) and AFI 32-7042, *Waste Management* (2014).

4.4.3.2 Alternative 2: Basic Maintenance Alternative

Under Alternative 2, it would be even less likely that existing contaminants associated with identified OUs at Edwards AFB would be mobilized because no new structures or facilities would be built. Similarly, the use of hazardous materials would be substantially less than for Alternative 1, and there would be no long-term change in the existing hazardous waste stream or hazardous waste management as a result of the development activities. With incorporation of MM HAZ-1, potential impacts to hazardous materials and hazardous waste would be reduced to a less than significant level.

4.4.3.3 Alternative 3: No Action Alternative

The No Action Alternative would be no change from current practices. On average, over the past 10 years, approximately 2 to 3 major projects have been constructed at Edwards AFB each year. Under the No Action Alternative, this minimal level of development would continue and future installation development projects would continue to be evaluated on an individual basis. As with Alternative 2, it would be even less likely that existing contaminants associated with identified OUs at Edwards AFB would be mobilized because no new structures or facilities would be built. Similarly, the use of hazardous materials would be substantially less than for Alternative 1, and there would be no long-term change in the existing hazardous waste stream or hazardous waste management as a result of the development activities. With incorporation of MM HAZ-1, potential impacts to hazardous materials and hazardous waste would be reduced to a less than significant level.

4.5 INFRASTRUCTURE

4.5.1 Methodology

To evaluate project-related impacts to infrastructure from the proposed alternatives, a review was conducted of existing infrastructure including the existing electrical, natural gas, water, waste water treatment, storm drain systems, transportation, and communication systems currently in place at Edwards AFB. Effects may occur from physical changes to existing infrastructure caused by implementing any of the proposed alternatives.

4.5.2 Significance Criteria

The following criteria were used in evaluating significance of impacts on infrastructure.

- The degree to which the increased demands from the proposed alternative would require the development of additional capacity or new facilities
- The degree to which the increased demands from the proposed alternative would reduce the reliability of utility service or transportation systems, or aggravate already existing adverse conditions in the affected region

4.5.3 Impacts Analysis

4.5.3.1 Alternative 1: High Intensity Development Alternative

The IDP is developed around the capabilities of existing infrastructure and facilities to meet current and projected mission needs (Edwards AFB, 2015a). This alternative could impact existing electrical, natural gas, water, storm drain systems, transportation, and/or communication systems currently in place at Edwards AFB. However, as noted in Section 2.1, IDP Objective 1.4, is to modernize utility systems and roadway networks to current standards. Build out under Alternative 1, High Density Alternative, accounts for construction and upgrades to utilities and infrastructure in all of the Planning Districts.

Electricity: The existing system has a maximum capacity of 79 MW, nearly double the 40 MW maximum demand registered for the installation. Known near-term development will not result in any significant increase in electrical distribution system demand (Edwards AFB, 2015a; IDP pages 7-11).

Natural Gas: Pacific Gas and Electric (PG&E) will supply additional future demands for natural gas. If the additional demand exceeds the capacity of the existing 10-inch supply line, the deliverable gas capacity will be increased through either the reinforcement of the existing line or the addition of a parallel supply line. With this assurance from PG&E, the natural gas supply is not a constraint for future development (Edwards AFB, 2015a).

Wastewater: According to the IDP, Edwards AFB has over five times the required capacity needed to accommodate base wastewater treatment demands. Overall, wastewater treatment components are in good condition. Other than periodic maintenance and upgrades, no major improvements for the sanitary sewer system are anticipated.

Stormwater: Overall the system appears to function at an acceptable level and was rated adequate in the IDP. Design of individual future projects should account for adequate utility design including stormwater drainage. Implementation of MM INF-1 would reduce impacts to a less than significant level.

Roadway Network: Buildout under Alternative 1 includes 4,100 linear feet of new roadways in the Radar Hill (1,000), North Base (3,100) and Community (unknown amount) Planning Districts. While the overall condition of the road network is adequate, there is not a current transportation network study or road and parking lot pavement condition analysis. When development at the installation is limited (as it has been for about 10 years), there is no need for additional information about the transportation network. However, if development substantially increases, which would be consistent with the IDP, then it will be important to identify capacity and long-term improvement requirements for roads, intersections, and parking lots. Implementation of MM INF-2 would help to reduce impacts to a level that is not significant.

Communications: It is anticipated that with implementation of Alternative 1, that the modernization of communications systems would continue to be implemented to ensure efficient and reliable operations.

MM INF- 1: Evaluate construction projects that could potentially affect stormwater flows and provide appropriate drainage improvements before project initiation.

MM INF-2: Complete an updated transportation network study of the entire installation to assess current conditions, analyze LOS, condition of roads, and key intersections.

4.5.3.2 Alternative 2, Basic Maintenance Alternative

Alternative 2 would consist of maintaining existing facilities so that they are kept operational to prevent mission degradation. This could include renovation or repurposing of existing structures to configure facilities to meet ever changing missions and further enhance planning district efficiency. Since no new facilities would be built, demand on existing infrastructure would be anticipated to be similar to existing conditions and no new impacts are anticipated. No mitigation would be required.

4.5.3.3 Alternative 3, No Action Alternative

Under Alternative 3, No Action Alternative, individual projects would continue to be evaluated on a project-by-project basis that could result in inefficient or redundant infrastructure improvements. Given the low level of development associated with the No Action Alternative, demand on existing infrastructure would be anticipated to be similar to existing conditions. Impacts would be similar to those for Alternative 1 although to a much lesser extent. Implementation of MM INF-1 and MM INF-2 would ensure that impacts remain at a less than significant level.

4.6 LAND USE

4.6.1 Methodology

Land use impacts are evaluated based on the level of consistency with relevant land use documents and potential to either be compatible or incompatible with surrounding land uses.

4.6.2 Significance Criteria

A NEPA evaluation must consider the context and intensity of the environmental effects that would be caused by, or result from, project Alternatives. There is no standard Federal guidance or established threshold pertaining to land use. Therefore, other environmental assessment documents must be reviewed; the criteria described below are used for the selected evaluation. An alternative would be considered to result in an adverse impact related to land use if it would:

- Conflict with relevant land use documents
- Be incompatible with existing and planned land uses

4.6.3 Impacts Analysis

4.6.3.1 Alternative 1: High Intensity Development Alternative

No significant effects on land use would occur from implementation of Alternative 1. The IDP describes the installation's past, present, and future physical state and guides future facility and infrastructure programming decisions. The IDP is the culmination of a comprehensive planning process and describes the 412th Test Wing's vision for its future physical state. The IDP builds upon previous planning studies to guide development recommendations. These studies include the 412th Test Wing's ADPs, environmental assessments, facility optimization plans, and other reports.

The IDP defines each land use category. In addition to the 11 land uses defined by *Air Force Pamphlet 32-1010*, two more land uses were developed for the IDP to accurately depict land uses at Edwards AFB. These land uses are Aerospace Research and Development and RDT&E. Table 4-3 is a sample of typical facilities found in each land use classification.

Table 4-3
Department of Defense Land Use Definitions

Land Use	Typical Facilities/Features
Administrative	Headquarters, Security Operations, Office
Aerospace Research and Development and Development	Laboratories, Test Stands, Equipment and Support Facilities for Aerospace Testing, Support Facilities for Aerospace Testing
Aircraft Operations/Maintenance	Hangers, Aircraft Maintenance Units (AMUs), Squadron Operations, Air traffic Control Tower, Fire Station
Airfield	Runways, Taxiways, Aprons, Overruns
Community (Commercial)	Commissary, BX, Clubs, Dining Facilities, Restaurants
Community (Service)	Gym/Recreation Center, Arts and Crafts, Air Force Flight Test Museum, Post Office, youth Center, Child Development Center, Public Schools, Chapel
Housing (Accompanied)	Privatized Family Housing
Housing (Unaccompanied)	Airman Housing, Visitor Housing- Vising Quarters, Temporary Lodging Facilities
Industrial	Civil Engineering, Maintenance Shops, Warehousing, Logistics
Medical	Hospital, Clinic, Pharmacy, Dental
Open Space	Conservation Areas, Buffer Space, Undeveloped Land with no specific use
Outdoor Recreation	Outdoor Courts, Athletic Fields, Golf Course
Research, Development, Testing, and Evaluation	Testing Ranges, Support Facilities, Safety and Security Buffers and Clearances

As noted in the IDP, future land use is not expected to change. Therefore, while the High Intensity Development alternative may result in more development, it would not result in a change in land uses that could create a potential conflict. Areas that are already developed—Main Base, North Base, South Base, the Community area, and the AFRL—will remain the only areas where new infill development is built. The RDT&E land use must be protected to ensure the 412th Test Wing's ongoing ability to meet mission requirements as the DoD's tester of choice.

The IDP identifies permitted functions and facilities by Planning District and describes the functions and facilities that are permissible within each Planning District, allowing development flexibility while maintaining land use compatibility. Within specific planning districts, functions or facilities may be prohibited or permitted with specific restrictions to ensure that development within those areas is not disruptive to the 412th Test Wing's missions. Furthermore, the form-Based Planning Guidelines provides recommendations that influence the quality and character of development to ensure that installation growth or redevelopment is achieved in an orderly, attractive, and cohesive manner. Therefore, land use impacts would be less than significant and no mitigation is required.

4.6.3.2 Alternative 2: Basic Maintenance Alternative

Impacts associated with Alternative 2 would be similar to Alternative 1 except that no new structures or facilities would be built. Alternative 2 would consist of maintaining existing facilities so that they are kept operational to prevent mission degradation. This could include renovation or repurposing of existing structures to configure facilities to meet ever changing missions and further enhance planning district efficiency. It may also include consolidation of functional areas and moving people around according to function or organization. No land use impacts are anticipated with renovation of existing structures since a facility should not be repurposed if it would result in an incompatible land use or would conflict with the IDP. Therefore, land use impacts would be less than significant and no mitigation is require.

4.6.3.3 Alternative 3: No Action Alternative

The No Action Alternative would be "no change" from current practices, or continuing with the present course of action until that action has changed. Projects would continue to be evaluated on an individual basis to determine land use consistency. Land use impacts would be less than significant and no mitigation is required.

4.7 NATURAL RESOURCES

4.7.1 Methodology

Natural resources that are addressed in this section include those identified in Section 3.7, as potentially occurring in the Planning Districts. This section presents the impact significance criteria that were used for analysis, followed by a discussion of impacts by alternative.

Within each of these sections, the Planning Districts are discussed in two sections: the Developed Planning Districts (including the first seven districts), and the Special Use Planning District, because natural resources on the installation are mostly concentrated in the Special Use Planning District and therefore impacts are similar in the first seven districts but considerably different for the Special Use Planning District.

In addition, the following resources are included under each section, and refer to those resources described in Section 3.7:

- General vegetation communities and wildlife
- Sensitive species and habitats (with subheadings for sensitive plants, sensitive wildlife, and sensitive habitats)

In each subsection, direct impacts are presented followed by indirect impacts. Indirect impacts occur later in time or are farther removed in distance while still being reasonably foreseeable and related to the project. After each discussion of a potentially significant impact, the mitigation measures that relate to that impact are presented, followed by a determination of the level of significance after mitigation. Impacts to natural resources may be both beneficial and adverse. A significant short-term adverse effect may exist even if the lead agencies believe that on balance the effect will be beneficial.

4.7.2 Significance Criteria

The following criteria were used to determine the severity and intensity of impacts:

- The degree to which the action may adversely affect an endangered or threatened species or designated critical habitat
- The degree to which the Proposed Project and alternatives affect local and regional populations of non-sensitive natural resources, and sensitive species and habitats. While a smaller adverse effect to a sensitive species (or any adverse effect to a listed species)

may be considered significant, these effects would need to be very large to have adverse effects on regional non-sensitive resources

- Whether an action significantly affects unique characteristics of the geographic area such as proximity to critical habitats, sensitive habitats, or other ecologically critical areas
- Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts
- Whether the action threatens a violation of Federal, State, or Local law or requirements imposed for the protection of the environment

4.7.3 Impact Analysis

4.7.3.1 High Density Development Alternative

Developed Planning Districts

General Vegetation and Wildlife Communities

Potential direct impacts include the disruption, trampling, or removal of rooted vegetation resulting in a reduction in the total acres of native vegetation. Potential indirect impacts include introduction of invasive species that compete with native species and can result in habitat degradation. Direct and indirect impacts will be most likely in the smaller edge areas of these Planning Districts where some native habitat remains, and unlikely to occur within developed areas where most surfaces are manufactured and vegetation is mostly non-native landscaping. Within the Developed Planning Districts these impacts are expected to be minimal and restricted to mostly areas that are previously disturbed and no longer support native vegetation, requiring no mitigation.

Wildlife communities could be directly affected by injury or mortality of individuals of local populations of non-sensitive species. This impact is expected to be less than significant as it is unlikely to affect a large number of individuals of regional populations, and requires no mitigation.

Direct impacts associated with the unauthorized take of a bird species or nests protected under the Migratory Bird Treaty Act (MBTA) would be considered a significant impact. These effects would be avoided or minimized by the implementation of MM-BIO-1, MM BIO-2 and MM BIO-3.

Indirect impacts within the Developed Planning Districts could include temporary effects of locally increased noise and dust. Because the developed portions of Edwards AFB support on-going activities that create loud noise (sonic booms, rocket tests, etc.) and blowing dust is a routine part of the desert natural environment, the temporary increase of these factors in localized areas is expected to be minimal and not result in adverse impacts. Implementation of MM AIR-5, MM AIR-7, MM AIR-8, MM AIR-9, MM AIR-10 and MM AIR-12 (from Section 4.1) as part of project construction would ensure that impacts are minimized.

MM BIO-1: Project Siting and Adherence to Base MMs

Projects would be sited preferentially as follows:

- Within areas covered by engineered surfaces such as asphalt or gravel
- Within already disturbed areas where native vegetation has been removed (bare soil or non-native vegetation)
- Within areas of native habitat, and only when the project cannot be sited elsewhere

The Basewide Biological Opinion (8-8-14-F-14; USFWS 2014 – found in Appendix F with terms and conditions listed on pages 7 through 11) shall be adhered to and the installation MMs will be followed to the extent possible and used during pre-project planning to assess and avoid potential impacts to biological resources.

MM BIO-2: Project Review/Pre-Construction Survey and Monitoring as Necessary

All projects would be submitted during the planning phases (i.e., 30% design) to the Edwards AFB Environmental Management office for review by a biologist familiar with the natural resources on the installation. If the biologist determines that the location and nature of the project does not require pre-construction surveys and/or monitoring, the project will proceed without such activities. If a pre-construction survey is deemed prudent, it will be conducted by a desert tortoise Authorized Biologist approved by the USFWS. If a preconstruction survey determines that monitoring is required, it will be conducted by a desert tortoise Authorized Biologist approved by the USFWS. Other reasonable and prudent avoidance or minimization measures may be deemed necessary by Environmental Management office review.

If deemed necessary by the biological review, biological monitors will be employed for the project to ensure that project activities:

- Use only personnel who have completed natural resources training, which can be conducted in the field as necessary
- Comply with all terms and conditions of the basewide Biological Opinion (8-8-14-F-14; USFWS 2014 – found in Appendix F with terms and conditions listed on pages 7 through 11), or other permitting related to that activity

- Do not result in the violation of any State and Federal Endangered Species Acts through the unauthorized take of a listed species
- Document all such training and compliance activity for inclusion in permitting reports as required

MM BIO-3: Avoidance of MBTA Violation

If possible, schedule all work outside of the nesting season (generally February through August but largely depending on seasonal weather patterns). If work is to occur during nesting season, conduct a nesting survey of the work area both within one week of the start of construction to identify potential nesting issues that can be avoided, and again immediately prior (within 24 hours) to the initiation of construction or demolition activities. If a nest is found during work activities, work will stop in the immediate area of the nest and a biologist will be called to inspect the nest and determine the best course of action, including the potential of establishing temporary avoidance areas until nesting is completed. Projects will be checked for nesting activities throughout construction or demolition activities at intervals determined by the project biologist and based on the type and location of the activities. Nest monitoring will be focused within the most common breeding season of February through August but may also be necessary in other seasons and will be conducted as determined for a specific project based on the project biologist's recommendations related to the nature and specific location of the activities.

Sensitive Species and Habitats

Sensitive Plants

Direct impacts to sensitive plants could occur from the removal of individuals during construction or demolition activities. No listed endangered or threatened plant species have been found on Edwards AFB. Desert cymopterus have been identified in the Main Base Planning District, red rock poppy near the boundary of the Flightline and Community Planning Districts, alkali mariposa lily near the boundary of the Flightline and South Base Planning District, and both desert cymopterus and sagebrush loeflingia in the AFRL Planning District. Because native habitats are mostly small remnants within the Developed Planning Districts, these impacts are not likely to be significant and do not require mitigation. However, with the implementation of MM BIO-1 and MM BIO-2 for other impacts, these impacts could also be recorded and larger populations of these species identified and avoided or impacts minimized where possible.

Indirect impacts to individuals and populations of sensitive plants include the increased potential for the spread of non-native invasive plant species that can displace native species. Because native habitats within the Developed Planning Districts are largely non-native and/or disturbed,

these impacts are not expected to be significant. Where larger areas of native habitats could be affected, the implementation of MM BIO-1, MM BIO-2, and MM BIO-4 would avoid and/or minimize impacts to sensitive plant species.

MM BIO-4: Management of Invasive Plants

During any project activities that occur within or adjacent to native habitats, or when project review by the biologist deems it necessary, the following measures will be implemented:

- If vehicles and equipment used will arrive from off-base, these vehicles and equipment will be cleaned prior to use at the site to avoid importing seeds of non-native species onto the installation
- Erosion control measures and borrow materials used will be certified weed free to the extent possible
- Landscaping of project areas will use only species native to the western Mojave Desert to avoid the spread of non-native species on the installation
- Herbicides must be applied in accordance with the Edwards AFB Integrated Pest Management Plan (2016)

Additional indirect impacts could occur to sensitive plants from the temporary or permanent disruption of water flows, or the introduction of nitrogen or heavy metals. These impacts are not likely to be significant with the inclusion of MM BIO-1 and MM BIO-2. Indirect impacts could also include temporary effects of locally increased noise and dust. Because the developed portions of Edwards AFB support on-going activities that create loud noise (sonic booms, rocket tests, etc.) and blowing dust is a routine part of the desert natural environment, the temporary increase of these factors in localized areas is expected to be minimal and not result in adverse impacts. Implementation of MM AIR-5, MM AIR-7, MM AIR-8, MM AIR-9, MM AIR-10 and MM AIR-12 (from Section 4.1) as part of project construction would ensure that impacts are minimized.

Sensitive Wildlife

Direct affects to sensitive wildlife species could result from the injury or mortality of individuals. Only one of the animals federally listed as endangered or threatened has been observed within the Developed Planning Districts at Edwards AFB: desert tortoise. The remaining federally listed species: California least tern and golden eagle (with similar protection under the federal Bald and Golden Eagle Protection Act): would most likely be occasional visitors within the

Developed Planning Districts and not likely to be directly affected by proposed activities. In addition, five additional state-listed species have been recorded within or very near the Developed Planning Districts (tricolored blackbird, Swainson's hawk, bank swallow, Townsend's big-eared bat, and Mohave ground squirrel). The direct injury or mortality of individuals of these species would be a significant impact. These impacts would be avoided and/or minimized by the implementation of MM BIO-1 and MM BIO-2.

Indirect impacts to desert tortoise could include temporary effects of locally increased noise and dust, reduction in food sources, burrow destruction and disrupting natural landmarks used for navigation. Because Edwards AFB currently supports on-going activities that create loud noise (sonic booms, rocket tests, etc.) and blowing dust is a part of the desert natural environment, the temporary increase of these factors in localized areas is expected to be less than significant and not require mitigation.

Additional indirect impacts to desert tortoise may occur from reduction in food sources, destruction of burrows, diversion of natural water flows, and disruption of navigational landmarks they may rely upon for navigation. Because the proposed projects in the developed planning areas are generally small in size and located on previously disturbed areas not adjacent to areas occupied by desert tortoise, these impacts are unlikely and do not require mitigation. However, if larger projects are proposed that may result in significant indirect impacts to desert tortoise or other listed species, MM BIO-1 and MM BIO-2 will be implemented to reduce these effects to a less than significant level.

Sensitive Habitats

Unauthorized adverse modification of critical habitat would be a significant impact. Approximately 40% of the AFRL Planning District (in the eastern areas) is within designated critical habitat for desert tortoise. MM BIO-1 would assist in the avoidance of these effects, and MM BIO 2 would avoid or minimize this impact by ensuring compliance with the basewide Biological Opinion.

The potential for the removal of a significant amount of Joshua tree woodland is low in the Developed Planning Districts as this community is not present is large acreage in these areas,

with the exception of almost 7,000 acres in the AFRL Planning District. These 7,000 acres represent approximately 0.3% of the regional community, with the likelihood of all of it being removed very low as this area mostly provides a buffer to the mission activities of the AFRL. Therefore, the removal of Joshua tree woodland associated with the proposed Project is unlikely to create a significant impact and does not require mitigation.

Wildlife movement corridors, including the Pacific flyway are unlikely to be adversely affected by the Proposed Project activities within the Developed Planning Districts and do not require mitigation.

Ephemeral drainages potentially under the jurisdiction of the state and local governments occur within all Developed Planning Districts and most have been disturbed by past activities within these areas and any impacts to these resources unlikely to be significant or require mitigation.

Special Use Planning District

General Vegetation and Wildlife Communities

Potential direct impacts include the disruption, trampling, or removal of rooted vegetation resulting in a reduction in the total acres of native vegetation. Potential indirect impacts include introduction of invasive species that compete with native species and can result in habitat degradation. Within the Special Use Planning District these impacts are expected to be restricted to less than one acre of new construction (Table 2-1 in Section 2.3) and as such are unlikely to create significant impacts and do not require mitigation.

Wildlife communities could be directly affected by injury or mortality of individuals of local populations of non-sensitive species. This impact is expected to be less than significant as it is unlikely to affect a large number of individuals of regional populations, and requires no mitigation.

Direct impacts associated with the unauthorized take of a bird species or nests protected under the MBTA would be considered a significant impact and could occur within project activity areas or in adjacent areas. These effects would be avoided or minimized by the implementation of MM BIO-1, MM BIO-2, and MM BIO-3.

Indirect impacts within the Special Use Planning District could include temporary effects of locally increased noise and dust. Because the developed portions of Edwards AFB support on-going activities that create loud noise (sonic booms, rocket tests, etc.) and blowing dust is a routine part of the desert natural environment, the temporary increase of these factors in localized areas is expected to be minimal and not result in adverse impacts. Implementation of MM AIR-5, MM AIR-7, MM AIR-8, MM AIR-9, MM AIR-10 and MM AIR-12 (from Section 4.1) as part of project construction would ensure that impacts are minimized**.**

Sensitive Species and Habitats

Sensitive Plants

Direct impacts to sensitive plants could occur from the removal of individuals during construction or demolition activities. No listed endangered or threatened plant species have been found on Edwards AFB, but all of the sensitive plants in Section 3.7.5 could be found within portions of the Special Use Planning District. If a larger number of individuals or an important population of a species were to be directly removed by the project, this impact would be considered significant. The implementation of MM BIO-1 and MM BIO-2 would reduce this impact to a less than significant level.

Indirect impacts to individuals and populations of sensitive plants include the increased potential for the spread of non-native invasive plant species that can displace native species. Because most areas of the Special Use Planning District support native habitats and are less disturbed, these impacts could be significant. The implementation of MM-BIO-4 would avoid and/or minimize impacts to sensitive plant species.

Sensitive Wildlife

Direct effects to sensitive wildlife species could result from the injury or mortality of individuals. Only one of the animals federally listed as endangered or threatened, the desert tortoise, is likely a resident within the majority of the Special Use Planning Districts at Edwards AFB.

The remaining three federally listed species: California least tern and golden eagle (with similar protection under the federal Bald and Golden Eagle Protection Act): would most likely be occasional visitors within the Special Use Planning Districts and not likely to be directly affected by proposed activities. In addition, five additional state-listed species have been recorded within or very near the Special Use Planning Districts (tricolored blackbird, Swainson's hawk, willow flycatcher, greater sandhill crane, bank swallow, Townsend's big-eared bat, and Mohave ground squirrel). Of these, the tricolored blackbird, willow flycatcher, and sandhill crane are restricted to edge areas of open water that occur only at Piute Ponds and Branch Memorial Park. Desert tortoises are found in varying densities throughout the Special Use Planning District, with the highest densities in the PIRA Sub-District. The direct injury or mortality of individuals of these species would be a significant impact. These impacts would be avoided and/or minimized by the implementation of MM BIO-1 and MM BIO-2.

Indirect impacts to these species could include temporary effects of locally increased noise and dust. Because Edwards AFB currently supports on-going activities that create loud noise (sonic booms, rocket tests, etc.) and blowing dust is a part of the desert natural environment, the temporary increase of these factors in localized areas is expected to be less than significant. Implementation of MM AIR-5, MM AIR-7, MM AIR-8, MM AIR-9, MM AIR-10 and MM AIR-12 (from Section 4.1) as part of project construction would ensure that impacts are minimized.

Sensitive Habitats

Unauthorized adverse modification of critical habitat would be a significant impact. The eastern and southern portions of the PIRA Sun-District are within critical habitat for desert tortoise. MM BIO-1 would assist in the avoidance of these effects, and MM BIO-2 would avoid or minimize this impact by ensuring compliance with basewide Biological Opinion.

Although the largest acreages of Joshua tree woodlands are found in the Special Use Planning Districts (particularly within the PIRA and Testing and Evaluation North Sub-Districts), less than an acre of this habitat would be removed by the Proposed Project.

Therefore, the removal of Joshua tree woodland associated with the proposed Project is unlikely to create a significant impact and does not require mitigation.

The Antelope Valley SEA and Wildlife movement corridors, including the Pacific flyway are unlikely to be adversely affected by the Proposed Project activities within the Special Use Planning Districts and do not require mitigation.

Ephemeral drainages potentially under the jurisdiction of the state and local governments occur within all Special Use Planning Districts and most are relatively undisturbed by past activities. The disturbance or removal of these resources may require coordination and/or permitting from state and local jurisdictions, especially where it could affect these resources off base and could result in a significant impact. The implementation of MM BIO-1 and MM BIO-2 will avoid or minimize this potential impact.

4.7.3.2 Basic Maintenance Alternative

General Vegetation and Wildlife Communities

Because there would be no construction on lands supporting native vegetation under the Basic Maintenance Alternative, no impacts are expected to general vegetation and wildlife and no mitigation would be required.

Potential impacts to nesting birds would be avoided or minimized by the implementation of MM BIO-3.

Sensitive Species and Habitats

Because there would be no construction on lands supporting native vegetation under the Basic Maintenance Alternative, no impacts are expected to sensitive species and habitats and no mitigation would be required.

If a project were to be proposed in areas of native habitat, including using these areas for personnel movement or equipment staging, MM BIO-1, MM BIO-2, MM BIO-3, and MM BIO-4 would be employed to avoid and minimize and potential impacts to natural resources.

4.7.3.3 No Action Alternative

Under the No Action Alternative, a minimal level of development would continue and future installation development projects would continue to be evaluated on an individual basis. For projects not proposed on lands supporting native vegetation, no impacts are expected to general vegetation and wildlife, nor to sensitive species and habitats and, therefore, no mitigation would be required.

If a project were to be proposed in areas of native habitat, including using these areas for personnel movement or equipment staging, MM BIO-1 through MM BIO-4, would be implemented to avoid and minimize and potential impacts to natural resources.

4.8 NOISE

4.8.1 Methodology

Noise may be generated from a point source, such as a piece of construction equipment, or from a line source, such as a road containing moving vehicles. Because noise spreads in an ever-widening pattern, the given amount of noise reaching an object, such as an eardrum, is reduced with distance from the source. For buildout according to the IDP, the primary source of noise would be temporary noise during construction and from operation of new roadways. Construction impacts would be temporary. Long term operational noise may result from new roadways and from the occasional use of equipment and vehicles for maintenance purposes. Noise impacts would be significant if they affect sensitive receptors, such as residences, schools, and medical clinics.

4.8.2 Significance Criteria

A project would normally have a significant effect if it were to substantially increase the ambient noise levels for adjoining areas or if it conflicts with adopted plans and goals of the community where it is located. In general, temporary construction activities that are over one-quarter mile from a sensitive receptor would not result in significant impacts.

To protect the public health and welfare with an adequate margin of safety, the USEPA guidelines recommend a $L_{eq}(24)$ of 70 dBA as the noise threshold for hearing loss prevention

(USEPA, 1974). The OSHA establishes workplace exposure guidelines that require hearing protection for people in close proximity to the noise levels, depending on exposure time, from 90 dBA to 115 dBA (OSHA, 2015).

4.8.3 Impacts Analysis

4.8.3.1 Alternative 1 – High Intensity Development Alternative

New noise sources resulting from implementation of Alternative 1 would be construction-related noise from vehicles and equipment. Noise impacts resulting from the operation of construction equipment would be short-term and temporary. The operation of construction equipment during excavation/earthmoving would produce elevated noise levels in the immediate vicinity of a project site. In many cases, noise levels and their impacts on sensitive receptors would be mostly mitigated by the gap between the construction site and receptors. However, there may be cases when construction may occur in closer proximity to sensitive receptors and MM NOI-1 has been identified to reduce potential impacts.

MM NOI-1: Noise levels could be reduced by limiting construction noise to daytime (e.g., 7:00 a.m. to 7:00 p.m.) and shortening work periods. In addition, noise levels would be minimized by keeping the construction activities at a distance from residential areas, where possible and where necessary. Where noise may be a concern during construction, monitoring at the receptor location may be considered to minimize impact to sensitive receptors and communities. Noise levels would return to background levels once construction activities cease.

Anticipated new sources of operational noise would include vehicular traffic from up to 4,100 linear feet of new roadways constructed in the Radar Hill (1,000 linear feet), North Base (3,100 linear feet), and Community (unknown amount) Planning Districts. Given the size of the installation and that these roads would be constructed generally in areas where there are already roads, no significant impacts would occur and no mitigation is required beyond MM NOI-1 for construction noise.

4.8.3.2 Alternative 2 – Basic Maintenance Alternative

Alternative 2 would consist of maintaining existing facilities so that they are kept operational to prevent mission degradation. This could include renovation or repurposing of existing structures to configure facilities to meet ever changing missions and further enhance planning district

efficiency. Since no new facilities would be built, noise impacts would primarily result from short-term temporary construction related activities. Similar to Alternative 1, with implementation of MM NOI-1, impacts from construction noise would be less than significant. No long-term operational noise impacts are anticipated since no new roads or facilities would be constructed. No mitigation is required for operational noise impacts.

4.8.3.3 Alternative 3, No Action Alternative

Under Alternative 3, No Action Alternative, individual projects would continue to be evaluated on a project-by-project basis. Each new project would require assessment of all noise-related impacts on sensitive receptors and local communities. Similar to Alternative 1, with implementation of MM NOI-1, impacts from construction noise would be less than significant.

4.9 SOCIOECONOMICS

4.9.1 Methodology

Assessing socioeconomic impacts requires both quantitative and qualitative measurements of the impact of a proposed development. For example, a proposed development may increase employment in the community and create demand for more affordable housing. Both effects are quantifiable. Assessing community perceptions about development requires the use of methods capable of revealing often complex and unpredictable community values. For the IDP project, it is difficult to quantify impacts as there are no specific projects proposed. Therefore, the analysis is at a high level and is qualitative. It is assumed that employment for construction and installation activities would be derived from local communities and from within Kern, Los Angeles, and San Bernardino counties.

4.9.2 Significance Criteria

Socioeconomic impacts would be considered significant if long-term employment rates or Edwards AFB's annual total economic impact to the region decreased. Socioeconomic impacts would also be considered significant if they substantially altered the location and distribution of the population within the region of influence; caused the population to exceed historic growth rates; decreased jobs so as to substantially raise the regional unemployment rates or reduce

income generation; substantially affected the local housing market and vacancy rates; or resulted in the need for new social services and support facilities.

4.9.3 Impacts Analysis

4.9.3.1 Alternative 1: High Density Alternative

The regional economy would benefit from increased expenditures incurred at Edwards AFB from construction activities for new or renovated facilities. Purchase of construction materials and services are anticipated to come from the local area. Construction workers would only be on Edwards AFB during working hours and would not constitute a change to the population. Under this alternative, impacts would be spread out over 5 to 10 years and no significant increases in personnel are expected. Construction workers are anticipated to come from the local area with companies primarily utilizing their existing employees. No adverse impacts are anticipated and no mitigation is proposed.

4.9.3.2 Alternative 2 – Basic Maintenance Alternative

Socioeconomic impacts to the local economy resulting from Alternative 2 will be substantially less than described for Alternative 1 because it is primarily a maintenance alternative.

4.9.3.3 Alternative 3: No Project Alternative

The No Action Alternative would be “no change” from current practices, or continuing with the present course of action until that action has changed. Projects would continue to occur on a project by project basis. Socioeconomic impacts to the local economy resulting from Alternative 3 will be substantially less than described for Alternative 1.

4.10 WATER RESOURCES

This section describes the water resources impacts that would occur with proposed development within the Planning Districts.

4.10.1 Methodology

The alternatives would not cause an increase in groundwater withdrawal at Edwards AFB. None selected would substantially deplete groundwater supplies or interfere substantially with

groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level. As a result, further analysis of this resource is not necessary.

To evaluate project-related impacts to water resources proposed alternatives, a review was conducted of previously completed investigations associated with the playa lake beds and surface water. The proposed alternatives and associated projects were reviewed for their potential impacts to water quality and ephemeral drainages, as well as potential flooding hazards. As discussed in Section 2.3.1, no projects are proposed in floodplain areas.

4.10.2 Significance Criteria

The evaluation of potential impacts on water resources is based on the Alternative's potential to affect water quality, surface water runoff volumes and drainage patterns, and flood hazards. Any selected alternative would have a significant impact on hydrology and water resources if it would:

- Violate any water quality standards or waste discharge requirements
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a wash, in a manner that would result in substantial erosion or siltation on- or off-site
- Substantially increase the potential for flooding or the amount of damage that could result from flooding
- Create or contribute runoff water which would exceed the capacity of existing or planned storm water drainage systems or provide substantial additional sources of polluted runoff

The selected alternative would have a significant impact from flood hazards if it would:

- Place within a 100-year flood hazard area structures which would impede or redirect flood flows
- Expose people or structures to a significant risk of loss, injury or death involving flooding as a result of the failure of a levee or dam, inundation by seiche, tsunami, or mudflow

4.10.3 Impacts Analysis

4.10.3.1 Alternative 1 – High Intensity Development Alternative

Main Base Planning District. Construction of potential projects in this district that involve ground disturbing activities has the potential for impacting surface water quality or waste

discharge requirements. This Planning District has not been identified as having the potential for flooding hazards.

Flightline Planning District. Construction of potential projects in this district that involve ground disturbing activities has the potential for impacting surface water quality or waste discharge requirements. While this planning district has not been identified as having the potential for flooding hazards, it is adjacent to Rogers Dry Lake bed that has been identified as being within a 100 year zone. To reduce hazards from flooding, construction should be limited to areas outside the 100-year flood zone associated with Rogers Dry Lake bed.

Community Planning District. Construction of potential projects in this district that involve ground disturbing activities has the potential for impacting surface water quality or waste discharge requirements. This planning district has been identified as having the potential for flooding hazards. Areas around Yeager Boulevard and Lancaster Boulevard have been identified as being within a 100 year zone.

Radar Hill Planning District. Construction of potential projects in this district that involve ground disturbing activities has the potential for impacting surface water quality or waste discharge requirements. This planning district has not been identified as having the potential for flooding hazards.

North Base Planning District. Construction of potential projects in this district that involve ground disturbing activities has the potential for impacting surface water quality or waste discharge requirements. This planning district has not been identified as having the potential for flooding hazards.

South Base Planning District. Construction of potential projects in this district that involve ground disturbing activities has the potential for impacting surface water quality or waste discharge requirements. While this planning district has not been identified as having the potential for flooding hazards, it is adjacent to Rogers Dry Lake bed that has been identified as being within a 100-year zone. To reduce hazards from flooding, construction should be limited to areas outside the 100-year flood zone associated with Rogers Dry Lake bed. In addition, it is

assumed that any work that needed to be done on a dry lake would be done when the lakebed is dry.

AFRL Planning District. Construction of potential projects in this district that involve ground disturbing activities has the potential for impacting surface water quality or waste discharge requirements. Flooding hazards have been identified in this planning district in unnamed drainages shown in the AFRL insert of Figure 3-7.

Special Use Planning District. While it is anticipated that this district remain mostly undeveloped, development in this district that involve ground-disturbing activities has the potential for affecting surface water quality or waste discharge requirements. Most of this district is undeveloped with natural drainages dominating the landscape. Flooding hazards have been identified for Rogers Dry Lake and Rosamond Dry Lake.

The following MMs would reduce potential impacts to water quality due to ground disturbing activities and erosion and flooding hazards within each district to less than significant.

MM HYD-1: Selected projects in any of the planning districts may require a SWPPP in support of a NPDES permit in connection with construction activities. Implementation of a SWPPP would protect downstream water quality, as sediment erosion would be controlled and sediment movement from the proposed alternative during construction would be reduced.

MM HYD 2: To reduce hazards from flooding, construction should be limited to areas outside 100-year flood zones.

MM HYD-3: No construction or earthmoving should occur that would result in the modification of existing natural drainages; nor should it occur on a dry lake that is not dry.

4.10.3.2 Alternative 2 – Basic Maintenance Alternative

Under Alternative 2, no construction would occur. Renovating or repurposing projects would not cause impacts to water quality as no new construction would occur. Renovation or repurposing would not increase flooding hazard risks. No mitigations would be necessary.

4.10.3.3 Alternative 3 – No Project Alternative

The No Action Alternative would be no change from current practices. On average, over the past 10 years, approximately 2 to 3 major projects have been constructed at Edwards AFB each year. Under the No Action Alternative, this minimal level of development would continue and future installation development projects would continue to be evaluated on an individual basis. Water impacts resulting from the minimal development of Alternative 3 would be similar but substantially less than described for Alternative 1. Therefore, MM HYD-1, MM HYD-2 and MM HYD-3 still apply.

4.11 CUMULATIVE IMPACTS

The CEQ regulations define “cumulative impact” as the impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Implementation of any of Alternative 2 (Basic Maintenance Alternative) or Alternative 3 (No Action Alternative) would not result in any appreciable change or increase in impacts for any resource analyzed in this EA because so little development would occur and would be limited to areas on Edwards AFB that have already been developed.

With implementation of Alternative 1 (High Intensity Development Alternative), impacts for most resources would be localized and negligible and, therefore, would have no impacts that would contribute to cumulative impacts in the area. However, there is the potential for cumulative impacts for air quality and GHGs, cultural and paleontological resources, and natural resources. A discussion is provided here for all resources, with particular emphasis on those resources with the potential for cumulative impacts.

4.11.1 Air Quality and Greenhouse Gases

Implementation of Alternative 1 would generate short-term temporary construction-related air and GHG emissions and, as described in Section 2.3.1, Alternative 1 is not expected to result in

significant increases in personnel at Edwards AFB thereby further limiting longer term impacts. Table 4-1 shows that emissions resulting from Alternative 1 would be well below established thresholds and would have no significant impact by itself. Implementation of MM AIR-1 through MM AIR-13 would further ensure that no significant impacts would occur. The temporary nature of project impacts, the limited amount of emissions and the distance from sensitive receptors and other proposed projects would ensure that no significant cumulative impacts would occur.

Compliance with all *Clean Air Act* Title V hazardous air pollutant requirements, or any other more stringent state or local requirements would be required for all alternatives and other projects. In addition, air emissions from future projects would be evaluated on a project-by-project basis to ensure anticipated emissions meet regulatory requirements. Consequently, significant cumulative impacts to air quality would not occur.

4.11.2 Cultural and Paleontological Resources

All cultural (archaeological and architectural) and paleontological resources are nonrenewable and avoidance is the best recommendation for limiting cumulative effects. With Alternative 1, most development would occur in or near areas that have already been disturbed and, therefore, would limit effects to cultural or paleontological resources. In addition, much of the installation has been surveyed or will be surveyed as part of proposed projects, thereby making avoidance easier. Impacts would be mitigated by implementation of MM CUL-1.

However, avoidance is not always feasible and damage or destruction of these types of resources results in a loss of information regarding prior use of the landscape and its historic context. Where one undertaking may have little effect on known resources, over time, additional projects have the potential to collectively affect the scientific value that cultural or paleontological resources may provide. With regard to cultural resources, Edwards AFB is currently examining the option of historic districts for better management of certain types of resources (both prehistoric and historical, with an emphasis on those resources within the Rosamond Lake Planning Sub-District). This approach may be more cost effective or feasible than conducting Phase II evaluation or Phase III data recovery on resources that may be affected

by proposed undertakings within these Planning Districts. These efforts should focus on documenting and comparing resources of similar temporal associations or functions, with thresholds for eligibility considerations; this allows for the best representation of a select site-type (e.g., recreational hunting; prehistoric subsistence strategies, etc.) to be preserved and managed through stewardship programs.

4.11.3 Geology and Soils

Impacts related to geology and soils would be localized and negligible. Because most project-related impacts are localized and none would be significant and, in fact, would all be substantially below a level of significance, there would be no impacts that would contribute to cumulative impacts in the area.

Continued and future development in the Antelope Valley has the potential for increasing wind and storm water erosion of soils. Unmitigated ground disturbance during Alternative 1 project implementation could add to wind and water erosion of soils. However, all impacts can be mitigated to a level that is not significant with implementation of MM GEO-3 and MM GEO-5.

4.11.4 Hazardous Materials and Hazardous Waste

Impacts related to hazardous materials and waste would be localized and negligible. Because there would be no change in existing hazardous materials and waste management, and all Federal, State and Local laws would continue to be observed, no adverse impacts would be expected and there would be no impacts that would contribute to cumulative impacts in the area.

4.11.5 Infrastructure

Construction and upgrades to utilities and infrastructure would occur entirely within the existing Edwards AFB footprint over a 5 to 10 year period. The proposed undertaking would enhance the infrastructure at Edwards AFB and reduce potential impacts to existing systems due to expanded uses. No cumulative impacts would occur.

4.11.6 Land Use

The IDP is a long-range planning document designed to accommodate the dynamic nature of mission needs. Buildout would occur entirely on base and is designed to be consistent with IDP goals and would minimize land use conflicts. No cumulative impacts would occur.

4.11.7 Natural Resources

General Vegetation and Wildlife Communities

A large number of cumulative projects have occurred or are proposed in the larger regional area of Edwards AFB. While some of these projects are located on previously disturbed lands such as those within developed areas or on lands currently in agricultural use, many are also on or proposed on undeveloped lands in native habitats. Projects proposed under the IDP (particularly with implementation of Alternative 1) may be located either on previously developed areas of non-native vegetation, or in undeveloped areas supporting native vegetation.

Cumulatively, implementation of Alternative 1 adds to the direct removal of regional native habitats and thus removal of general vegetation and wildlife species. Cumulative indirect impacts are also possible through increased fragmentation of habitat and introduction or increases of non-native plants and wildlife.

Those projects proposed on previously developed lands would not be likely to have impacts on natural resources and do not require mitigation. Projects proposed on or near areas of non-native vegetation would employ MM BIO-4 in order to avoid or minimize the spread of non-native species into areas of native vegetation. Projects proposed in areas of native vegetation would employ MM BIO-1, MM BIO-2, and MM BIO-3 to avoid and minimize impacts to natural resources. The resulting impacts are not expected to be significant.

In addition, temporary effects of locally increased dust resulting from construction would be minimized by implementation of MM AIR-5, MM AIR-7, MM AIR-8, MM AIR-9, MM AIR-10 and MM AIR-11.

Sensitive Species and Habitats

Cumulatively, the proposed project could add to the direct removal of sensitive plants and wildlife being removed in the region, when the IDP is added to other regional projects, including federally listed species such as the desert tortoise and golden eagle. Cumulative indirect impacts to sensitive plants are also possible through the introduction or increase of non-native plants that can out-compete native species. Cumulative indirect impacts are also possible to sensitive wildlife through the introduction or increase of non-native plants that can out-compete native species needed for forage, also potentially affecting prey populations for predators. Introductions or increases in non-native predator populations are also a potentially-significant result of these projects cumulatively as they could alter the native populations in the regional area.

Although the impacts associated with implementation of Alternative 1 to sensitive habitats is not likely to be significant, the cumulative impacts of all of these projects within the regional area creates a situation where the Proposed Project may add to the direct removal of Joshua tree woodlands. Cumulative indirect impacts to both Joshua tree woodlands and wildlife movement corridors are also possible through increased fragmentation of habitat and introduction or increases of non-native plants.

Those projects proposed on previously developed lands would not be likely to have impacts on natural resources and do not require mitigation. Projects proposed on or near areas of non-native vegetation would employ MM BIO-4 in order to avoid or minimize the spread of non-native species into areas of native vegetation. Projects proposed in areas of native vegetation would employ MM BIO-1, MM BIO-2, and MM BIO-3 to avoid and minimize impacts to natural resources. These measures would ensure that cumulative impacts to natural resources would not be significant.

In addition, temporary effects of locally increased dust resulting from construction would be minimized by implementation of MM AIR-5, MM AIR-7, MM AIR-8, MM AIR-9, MM AIR-10 and MM AIR-11.

4.11.8 Noise

Development associated with Alternative 1 would result in short-term, localized temporary noise impacts from construction vehicles and equipment and long-term from vehicles on new roadways. Cumulative impacts would result if the Proposed Action caused a permanent increase in ambient noise levels. Anticipated long-term sources of noise include vehicles traveling on the new roadways that would be located entirely on base. However, changes in vehicular traffic associated with Alternative 1 are expected to be negligible and, therefore, no cumulative impacts are expected.

4.11.9 Socioeconomics

Development would occur entirely within the existing Edwards AFB footprint over a 5 to 10 year period. Development could temporarily increase local populations and associated housing, although the construction projects would be temporary. Economic expenditures associated with construction and renovation at Edwards AFB when combined with other local development projects are anticipated to cumulatively benefit the regional economy, although such expenditures associated with development on Edwards AFB are not expected to be significant, particularly since, as discussed in Section 2.3.1, no significant increases in personnel are expected as part of this project.

4.11.10 Water Resources

Impacts related to hydrology and water quality impacts resulting from potential erosion would also be localized and would be reduced to less than significant levels with the incorporation of standard erosion and drainage control measures as would be found in a SWPPP.

4.12 UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse impacts include those impacts that are negative, occurring regardless of any identified MMs. All adverse impacts associated with Alternative 1 (High Intensity Development Alternative) would not be significant or would be reduced to a level that is not significant, as discussed in Sections 4.1 through 4.10, and summarized in Section 2.6. Impacts associated with each resource for this alternative are summarized here. Unavoidable adverse impacts associated with Alternative 2 (Basic Maintenance Alternative) and Alternative 3 (No Action Alternative)

would be less than Alternative 1 (High Intensity Development Alternative) and, therefore, this section focuses primarily on Alternative 1 impacts.

4.12.1 Air Quality and Greenhouse Gases

Minor pollutant emissions from Alternatives 1, 2 and 3 and other foreseeable projects are unavoidable. These include emissions from vehicles used in the construction or remodeling of projects. Even for the worst-case scenario, Alternative 1, these emission levels do not represent any significant increase to current base-wide emissions. As discussed in Section 4.1, construction and operational emissions would be well below significance thresholds and would not be significant. Incorporation of MM AIR-1 through MM AIR-13 to minimize fugitive dust emissions and to ensure compliance with permitting requirements and state off-road regulations would further reduce air quality and GHG emissions.

4.12.2 Cultural and Paleontological Resources

Demolition and construction, and other activities associated with Alternatives 1, 2 and 3 could affect cultural resources (both archeological and architectural resources) at Edwards AFB. In areas not previously surveyed, a cultural resources survey should be performed prior to the onset of the construction, demolition, installation, or enlargement, with Formal evaluation conducted as warranted. While avoidance is the preferred treatment for cultural resources, avoidance is not always feasible. In such situations, a cultural resources monitor may be present for the duration of the ground disturbance or renovations. However, with incorporation of MM CUL-1, potential impacts to cultural resources would be reduced to a less than significant level.

4.12.3 Geology and Soils

Construction of projects would not damage or destroy existing landforms found within the Planning Districts. Most development would occur in areas adjacent to existing development or in areas previously disturbed. Any project within any of the Planning Districts has the potential to be impacted by the geology or soils that may become unstable during a seismic event. While there are no known active faults on Edwards AFB, active faults are found within the region. Impacts would be minimized by implementation of standard construction methods and, where applicable, implementation of MM GEO-1. Construction of projects identified in Alternative 1

may have a high potential for soil loss due to wind erosion for all planning districts at Edwards AFB. Once construction is complete, potential loss of soil due to wind or storm water erosion would not likely exceed current developed conditions found throughout much of Edwards AFB. Impacts would be less than significant with implementation of MM GEO-2 through MM GEO-5.

4.12.4 Hazardous Materials and Hazardous Waste

Construction and operation of projects associated with Alternative 1 would not mobilize existing contaminants associated with identified OUs at Edwards AFB in groundwater or soil, or expose workers to contaminated soils or groundwater. No adverse impacts related to ERP would be expected and no mitigation is required.

The use of hazardous materials during development under Alternative 1 is anticipated to be limited to construction vehicle maintenance activities and construction materials. These materials would be required to be properly contained, manifested, and managed in accordance with all Federal, State, and Local regulations, AFIs, and DoD Directives. No long-term change in existing hazardous materials and hazardous waste management would occur as a result of any development. All Federal, State, and Local environmental laws would continue to be observed, as well as preventative measures contained in the Edwards AFB HWMP. As such, no adverse impacts related to hazardous materials and waste would be expected under Alternative 1 and no mitigation is required.

4.12.5 Infrastructure

In general, the infrastructure systems at Edwards AFB (electricity, natural gas, wastewater, stormwater, roadway network) are functioning at acceptable levels. Implementation of MM INF-1 and MM INF-2 would help to reduce impacts to a level that is not significant.

4.12.6 Land Use

No significant effects on land use would occur from implementation of the IDP as future land use is not expected to change. No mitigation is required.

4.12.7 Natural Resources

Potential direct impacts to general vegetation and wildlife communities, as well as sensitive species and habitats could occur primarily in areas where ground disturbing activities may occur. Indirect impacts to individuals and populations of sensitive plants include the increased potential for the spread of non-native invasive plant species that can displace native species. Implementation of MM BIO-1 through MM BIO-4 would reduce impacts to a less than significant level.

4.12.8 Noise

Construction noise would be primarily from construction vehicles and equipment. Impacts would be short term and temporary. Implementation of MM NOI-1 would reduce impacts to a less than significant impact. Operational noise could come from additional trips but would not be significant.

4.12.9 Socioeconomics

The regional economy would benefit from increased expenditures incurred at Edwards AFB from construction activities for new or renovated facilities. Under this alternative, impacts would be spread out over 5 to 10 years and no significant increases in personnel are expected. Construction workers are anticipated to come from the local area with companies primarily utilizing their existing employees. No adverse impacts are anticipated and no mitigation is proposed.

4.12.10 Water Resources

Construction of potential projects that involve ground disturbing activities has the potential to impact surface water quality or result in erosion. New development is not proposed in flood hazard areas. Implementation of MM HYD-1 through MM HYD-3 would reduce impacts to a less than significant level.

4.13 SHORT-TERM VERSUS LONG-TERM PRODUCTIVITY OF THE ENVIRONMENT

Examples of short-term uses of the environment include direct, construction-related disturbances and direct impacts associated with an increase in population and activity that occurs over a period typically less than 5 years. Long-term uses of the environment include impacts occurring over a period of more than 5 years, including permanent resource loss.

Implementation of Alternative 2 (Basic Maintenance Alternative) and Alternative 3 (No Action Alternative) would not result in any changes in use at Edwards AFB and, impacts would be less than for Alternative 1 (High Intensity Development Alternative) and, therefore, this section discusses the impacts associated with Alternative 1.

With implementation of Alternative 1 (High Intensity Development Alternative), development of individual projects could result in minor, temporary, direct construction-related disturbances. Permanent long-term resource loss is unlikely because most projects would be built in areas that have already been disturbed or consist of renovating existing structures. In the event that a project would require disturbance of new ground, appropriate surveys (particularly for biological and cultural resources) and mitigation or avoidance of impacts would be undertaken to reduce or eliminate significant impacts. Basic mitigations are provided for each resource in this EA in Section 2.6 and in each resource impact discussion in Sections 4.1 through 4.10. In addition, as described in Section 2.3.1, Alternative 1 is not expected to result in significant increases in personnel at Edwards AFB and, consequently, would not result in long-term increases in the population of the area. Consequently, there would be no significant short-term or long-term changes in population or productivity of the environment as a result of this alternative.

4.14 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

In accordance with NEPA (40 CFR 1502.16), this section includes a discussion of any irreversible and irretrievable commitment of resources associated with the Proposed Action. Irreversible and irretrievable resource commitments are related to the use of nonrenewable natural resources and the effects that the use of those resources will have on future generations.

Irreversible effects primarily result from the use or destruction of a specific resource (e.g., energy and minerals) that cannot be replaced within a reasonable time frame. Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored as a result of implementing an action (e.g., extinction of a rare or threatened species, or the disturbance of an important cultural resource site).

Implementation of Alternative 2 (Basic Maintenance Alternative) would not require an irreversible or irretrievable commitment of resources because so little development would occur and would be limited to areas that have already been developed.

With implementation of Alternative 1 (High Intensity Development Alternative) or Alternative 3 (No Action Alternative), there would be no irreversible or irretrievable commitment of resources for any of the environmental resources analyzed in this EA, except possibly for cultural resources (archaeological or architectural resources). Biological resources are also discussed here but are unlikely to result in the irreversible or irretrievable commitment of resources if appropriate mitigation measures are implemented.

A commitment of resources is irreversible when its primary or secondary impacts limit the future option for a resource. An irretrievable commitment refers to the use or consumption of resources that is neither renewable nor recoverable for later use by future generations, such as the loss of cultural resources or paleontological resources, or biological resources. Thus, any ground disturbance that may encounter cultural resources could result in the destruction of these nonrenewable resources. Ground disturbance could temporarily or permanently affect biological resources as well, although impacts are more likely to be temporary or avoidable.

For good stewardship of the resources identified in the project areas, all previously unevaluated archaeological sites should be formally evaluated for inclusion to the NRHP, with site-specific mitigation being developed prior to the proposed construction activities. Under NHPA, cultural resources eligible for listing in the NRHP would be protected from development. Native American resources, once destroyed or altered, cannot be replaced; any loss of sacred sites or traditional cultural properties would be considered irreversible and irretrievable.

For natural resources, development (especially in undisturbed areas) would result in temporary impacts associated with construction and permanent impacts in areas where habitat may be lost. With proper mitigation, both temporary and permanent impacts can be mitigated such that there would be no irreversible or irretrievable commitment of natural resources.

5.0 REFERENCES

AECOM

2010 *Oro Verde Solar Project Draft Preliminary Habitat Assessment*. Edwards Air Force Base, California.

Air Force Flight Test Center

1993 *Biological Resources Environmental Planning Technical Report Focused Sensitive Species Survey*. Prepared by Tetra Tech, Inc. Edwards Air Force Base, California.

Antelope Valley Air Quality Management District Planning, Rule-making and Grants Section

2011 *California Environmental Quality Act (CEQA) and Federal Conformity Guidelines*.

Baldwin, B. G., G. H. Goldman, et al., Eds.

2012 *The Jepson Manual*; Vascular Plants of California, Second Edition. Berkeley, CA, University of California Press.

Boyer, B.

2005 Phase II Cultural Resource Evaluation for Construct New West Gate Road for Commercial Vehicles at Edwards AFB, Kern County, California. On file at the Air Force Flight Test Center, Base Historic Preservation Office, Edwards Air Force Base, California.

Bupp, S, E. Chandler, C. Cotterman, K. Doyle, K. Guerrero, V. Hallett, and B. Smith

1998 The Legacy of Buckhorn Springs: Phase I and II Cultural Resource Investigations, Edwards AFB, Kern County, California. Volumes I and II. Tetra Tech, Inc. On file at the Air Force Flight Test Center, Base Historic Preservation Office, Edwards Air Force Base, California.

California Native Plant Society (CNPS)

2013 CNPS Inventory of Rare and Endangered Plants for Bissell, Cache Peak, California City South, Edwards, Little Buttes, Mojave, Mojave Northeast, Monolith, Rosamond, Rosamond Lake, Redman, Sanborn, Soledad Mountain, Tehachapi North, Tehachapi Northeast, Tehachapi South, Tylerhorse Canyon, and Willow Springs USGS 7.5-Minute Quadrangles California, CNPS.

California Air Resources Board

2016 *Ambient Air Quality Standards*. May 4, 2016. http://www.arb.ca.gov/research/aaqs/aaqs2.pdf. Accessed June 2016.

2015 *Area Designation Maps/State and National*. December 2015. http://www.arb.ca.gov/desig/adm/adm.htm. Accessed June 2016.

2014 *California Greenhouse Gas Inventory for 2000-2012 — by Category as Defined in the 2008 Scoping Plan*. March 24, 2014. http://www.arb.ca.gov/cc/inventory/pubs/reports/ghg_inventory_00-12_report.pdf. Accessed June 2016.

California Department of Fish and Game

2008 Fish and Game Code Section 3800-3806, from http://www.leginfo.ca.gov/cgi-bin/displaycode?section=fgc&group=03001-04000&file=3800-3806

2009 *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities*

2012 *Staff Report on Burrowing Owl Mitigation*, Department of Fish and Game.

California Department of Water Resources

2004 Bulletin No. 118, South Lahontan Hydrologic Region, Middle Mojave River Valley Groundwater Basin (6-41)

Bulletin No. 118, South Lahontan Hydrologic Region, Antelope Valley Groundwater Basin (6-44)

Bulletin No. 118, South Lahontan Hydrologic Region, Fremont Valley Groundwater Basin, Basin (6-46)

Bulletin No. 118, South Lahontan Hydrologic Region, Harper Valley Groundwater Basin, (6-47)

California Governor's Office of Planning and Research

2005 State of California: Tribal Consultation Guidelines, Supplement to General Plan Guidelines. November.

Coughlan, K., Gesswell, H. and McKenzie, J. M.

2002 Soil Physical Measurements and Interpretation for Land Evaluation. CSIRO Publishing, Collingwood, Victoria, Australia

County of Kern

2006 *Guidelines for Preparing an Air Quality Assessment for Use in Environmental Impact Reports*. Bakersfield.

Crosby, D.

2010 Standards and Procedures Manual for the Archaeological Data Center and Curatorial Functions of the Curation Facility at Edwards Air Force Base, California. JT3/CH2M HILL, Edwards Air Force Base, California. Submitted to 95th Air Base Wing Civil Engineer Division, Environmental Management, Base Historic Preservation Office, Edwards Air Force Base, California, Contract F42650-01-C-7218.

Department of Conservation, California Geological Survey

2005 "Seismic Hazard Zone Report for the Rosamond 7.5-Minute Quadrangle, Los Angeles County, California." *Seismic Hazard Zone Report 093*. California Geological Survey's Publication Sales Office, Los Angeles, California.

Dibblee, T. W., Jr.

1960 Geology of Rogers Lake and Kramer Quadrangles, California. U.S. Geologic Survey Bulletin 1089-B, p. 73-119.

Dinehart, R. L. and Harmon, J. G.

1998 Potential Overflow of Mojave Creek near Disposal Site, Edwards Air Force Base, California. U.S. Geological Survey Open File Report 98-97. Prepared in Cooperation with the U.S. Department of the Air Force.

ECORP Consulting

2013 *Final Biological Technical Report for the Oro Verde Solar Project*, Enhanced Use Lease and Gen-tie Study Areas, Edwards Air Force Base, Kern County, California. December 2013.

ECORP Consulting, Inc.

2013 Phase I Cultural Resources Inventory for the Oro Verde Solar Project Near the Town of Mojave and Kern County, California, and Within Management Region 1, Edwards Air Force Base, California. Prepared for the United States Air Force, Edwards Air Force Base, California, Environmental Management Office.

EKCAPCD (Eastern Kern Air Pollution Control District)

2012 *Eastern Kern Air Pollution Control District Policy – Addendum to CEQA Guidelines Addressing GHG Emission Impacts For Stationary Source Projects When Serving As Lead CEQA Agency*.

Earle, D. D., Boyer B. L., Bryson, R.A., Bryson, R.U, Campbell, M.M., Johannesmeyer, J.J., Lark, K.A., Parker, C.J., Pittman, M.D., Ramirez, L.M., Ronning, M.R., and Underwood, J.

1997 Cultural Resources Overview and Management Plan for Edwards AFB, California, Volume 1: Overview of Prehistoric Cultural Resources. Computer Sciences Corporation, Edwards Flight Test Center. March. Prepared for the United States Air Force, Edwards Air Force Base, California, Environmental Management Office.

Earle, D. D., Lark, K. A., Parker, C. J., Ronning, M. R. and Underwood, J.

1998 *Cultural Resources Overview and Management Plan for Edwards AFB, California, Volume 2: Overview of Historic Cultural Resources*. Computer Sciences Corporation, Edwards Flight Test Center. March. Prepared for the United States Air Force, Edwards Air Force Base, California, Environmental Management Office.

Edwards Air Force Base (EAFB)
1994 *Edwards Air Force Base Revegetation Plan*. Air Force Flight Test Center, Environmental Management Office, Edwards Air Force Base, California

1994 *Programmatic Environmental Assessment for Basewide Implementation of the Installation Restoration Program at Edwards Air Force Base, California*. Prepared for U.S. Army Corps of Engineers Sacramento District and the Air Force Flight Test Center, Environmental Management Office, Edwards Air Force Base, California. Prepared by GRW Engineers, 801 Corporate Drive, Lexington, Kentucky and Tetra Tech, Inc. 348 W. Hospitality Lane, Suite 300, San Bernardino, California.

2017a Edwards Air Force Base Final Integrated Cultural Resources Management Plan (ICRMP), 32-7065. Base Historic Preservation Office, Curation Center, Edwards AFB.

2012c *Comprehensive Base-Wide Habitat Restoration Plan*. Environmental Management Office, Edwards Air Force Base, California.

2012d *Environmental Assessment for the Air Force Base Research Laboratory Security Fence Project*. November.

2014 *Environmental Assessment for the Routine and Recurring Realignment of Units and Personnel at Edwards Air Force Base*

2015a *Installation Development Plan, 412th Test Wing, Edwards Air Force Base*. July.

2015b *Edwards Air Force Base Economic Impact Analysis Fiscal Year 2015.*

2016 *Edwards Air Force Base Final Integrated Natural Resources Management Plan* (INRMP), Edwards Air Force Base, California.

Federal Emergency Management Agency
2016 Flood Zone Definitions. http://www.fema.gov/flood-zones; accessed on 20 June 2016

Giambastiani, M., Ghabhláin S. N., Hale M., Catacora A., Iversen D., and Becker M.
2007 Final Phase II Cultural Resource Evaluation at 21 Sites Along the West and Northwestern Boundaries, Edwards AFB, Kern and Los Angeles Counties, California. ASM Affiliates, Inc., Carlsbad, California under contract to Earth Tech, Colton, California. On file at the Base Historic Preservation Office, Edwards Air Force Base, California.

Giambastiani, M., Hale, A.M., Cole, C.R., and Moore, S. J.
2013 *Evaluations, Archaeological Sites (Mesquite Processing), Range: Edwards Air Force Base, California.* Prepared by ASM Affiliates, Inc., Reno, Nevada, for Richard Bark, EAFB, and Stephen Dibble, USACE Los Angeles.

Green, T., Walsh, M.R., Van Wyke, A.J., and Clewlow, C.W., Jr.
2002 Cultural Resource Testing and Phase II Evaluation for the Protection of Six Sites at Edwards Air Force Base, California. Submitted to U.S. Army Corps of Engineers Sacramento District, California, Contract No. DACA05-96-0004, for U.S. Air Force Flight Test Center, Base Historic Preservation Office, Edwards Air Force Base, California. On file at the Base Historic Preservation Office, Edwards Air Force Base, California.

Hailstone, Misty
2017 US Air Force 412th CEG/CEVA, personal communication, 3 February 2017.

Hale, M. and Nicholas, H.
2014 Cultural Resources Inventory of Proposed Utility Corridors Associated with the Edwards AFB Area Development Plan Kern and Los Angeles Counties, California. Dudek, December. Prepared for the 412th Civil Engineer Directorate Environmental Management Division Assets Branch, Edwards Air Force Base, California.

Hazelton, P. A. and Murphy, B.
2007 Interpreting Soil Test Results. CISRO Publishing, Collingwood, Victoria, Australia

Hector, S. M., Gross, G.T., Wade, S.A., Manley, W.R., Haynal, P.M., and Cheever, D.M.
1988 *Cultural Resource Investigation for the Farm Drop Zone, Edwards Air Force Base, California.* Regional Environmental Consultants (RECON), San Diego, California. Submitted to Air Force Flight Test Center, Office of Environmental Planning, Management and Compliance (DEV), Edwards Air Force Base, California, Contract No. F04700-87-CO190. On file at the Base Historic Preservation Office, Edwards Air Force Base, California.

Holmes, A. M., Hogan, S.C., and Parker, M.P.
2004 *A Phase II Evaluation of 22 Archaeological Sites Located within MR1, Edwards Air Force Base, California.* Earth Tech, Colton, California. Submitted to the U.S. Army Corps of Engineers, Sacramento District, Contract No. DACA-05-01-D-0006, for Air Force Flight Test Center, Base Historic Preservation Office, Edwards Air Force Base, California.

Jennings, C. W. and Strand, R. G.
1969 Geologic Map of California: Los Angeles Sheet. California Division of Mines and Geology. 1:250,000. Sixth printing: 1991.

Jones and Stokes Associates, Inc.
1998 *Final Phase II Evaluation of the South Base Sled Track, Edwards Air Force Base, Los Angeles and Kern Counties, California.* Prepared for the US Army Corp of Engineers and the Earth Tech, Colton, California. Submitted to the U.S. Army Corps of Engineers and the U.S. Air Force Flight Test Center, Environmental Management Office, Edwards Air Force Base, CA. On file at the Edwards Air Force Base Curation Facility, Edwards Air Force Base, California

King, E. and H. Spinney
2010 *Phase II Evaluation of Selected Damage V Archaeological Sites, Edwards AFB, California.* Tetra Tech, Inc. Document on file at the Edwards Air Force Base Curation Facility, Edwards Air Force Base, California.

King, E., H. Spinney, J. Howard, M. Knypstra and E. Chandler
2010 *Phase II Evaluation of Selected Damage V Archaeological Sites, Edwards AFB, California.* Prepared by Tetra Tech, Inc. San Francisco, California, with contributions by ECORP Consulting, Inc., Redlands, California. Prepared for U.S. Army Corps of Engineers, Sacramento, California.

Macko, M. E.
1993 Cultural Resources Investigation of the Proposed AT&T Lightguide System, Victorville to Bakersfield, California. Macko Archaeological Consulting. Document on file at AFFTC/EM, Edwards AFB, CA.

L. McGetrick, Boyer, B., Campbell, M., Loren-Webb, B., and Ronning, M.
2002 Overview and Results of the Sample Survey for Cultural Resources Management Region 3, Edwards AFB, Kern and Los Angeles Counties, California, Computer Sciences Corporation and JT3/CH2M Hill, Edwards AFB, California. Submitted to the Air Force Flight Test Center, Base Historic Preservation Office, Edwards Air Force Base, California, Contract No. F04611-92-C-0045 and F42650-01-C-7218. On file at the Base Historic Preservation Office, Edwards AFB, California.

McLeod, S. A.
2014 Paleontological Resources for the Proposed Oro Verde Solar Project, Project # 2012-003.001, from West of Mojave to the Bissell Hills, Kern County, project area. Natural History Museum of Los Angeles County, Vertebrate Paleontology Section, Los Angeles. July.

Mojave Desert Air Quality Management District
2011 *California Environmental Quality Act (CEQA) and Federal Conformity Guidelines*.

Natural Resources Conservation Service
2012 Soil Survey for Edwards Air Force Base, California, Parts of Kern, Los Angeles and San Bernardino County (CA669).

Parker, C. J.
2001 *Phase II Cultural Resource Evaluation for 20 Sites, Edward AFB, Kern, Los Angeles, and San Bernardino Counties, California.* Document on file at the San Bernardino Archaeological Information Center, San Bernardino, California.

Puckett, H. R., Parker M. P., and Bark R. G.
2003 A Phase II Evaluation of 94 Archaeological Sites Located Along Roads throughout Edwards Air Force Base, California. Volume III: A Report of Findings for 38 Historic Period Sites. Earth Tech, Colton, California. Submitted to the US Army Corps of Engineers, Sacramento District, Contract No. DACA-05-01-D-0006, for Air Force Flight Test Center, Base Historic Preservation Office, Edwards Air Force Base.

Puckett, H. R. and Peyton. P. M.
2008 *FINAL Theme Study, Inventory and Evaluation for Various Historic Period Site Types, Edwards Air Force Base, California. Volume I.* Tetra Tech, Inc., and KAYA Associates, Inc. Contributions by Harriot E. Spinney, Mari A. Pritchard Parker and Valerie Parker. August. Prepared for the U.S. Corps of Engineers, Contract DACA-05-01-0005, Task 0104. On file at the Base Historic Preservation Office, Edwards Air Force Base, California. File No. 2006-L, Project ID: THEME7.

Puckett, H. and Spinney, H.
2004 Mines and Mining-Related Sites on Edwards Air Forces Base, California: A Phase II Evaluation of 75 Sites and Thematic Synthesis. Tetra Tech, Inc., San Bernardino, California. On file at the Base Historic Preservation Office, Edwards Air Force Base, California.

Puckett, H. and Spinney, H.
2005 *Historic Period Refuse Deposits on Edwards Air Force Base, California: A Phase II Evaluation of 61 Sites.* Tetra Tech, Inc., San Bernardino, California and Jones & Stokes, Sacramento, California. On file at the Base Historic Preservation Office, Edwards Air Force Base, California.

Rogers, T. H.
1967 Geologic Map of California: San Bernardino Sheet. Division of Mines and Geology. 1:250,000. Seventh printing: 1998.

Ronning, M. R., M. D. Pittman, and Underwood J.
1997 *Cultural Resources Overview and Management Plan for Edwards AFB, California, Volume 3: Cultural Resources Management Plan.* Computer Sciences Corporation, Edwards Flight Test Center. November. Prepared for the United States Air Force, Edwards Air Force Base, California, Environmental Management Office.

Spinney, H. and J. Mates
2010 *Range Evaluations Archaeological Sites (Theme V) Edwards Air Force Base, California.* Tetra Tech, Inc., San Bernardino, California. Document on file at the Edwards Air Force Base Curation Facility, Edwards Air Force Base, California.

Spinney, H.

2004 Cultural Resource Evaluation of Historic Period Homesites on Edwards Air Force Base, Kern and Los Angeles Counties, California. Volume II: Findings. Tetra Tech, Inc., San Bernardino, California. Submitted to Air Force Flight Test Center, Base, Historic Preservation Office, Edwards Air Force Base, California. Contract No.: DACA-05-01-D-0005, Task Order 0031

Sutton, M.Q., and R. W. Robinson

1977 *Final Report on the Mitigation Procedures for the Cultural Resources on the Space Shuttle Transport Road.* Prepared for the Army Corps of Engineers, Los Angeles, California. Submitted to Air Force Flight Test Center, Base, Historic Preservation Office, Edwards Air Force Base, California.

Tetra Tech, Inc.

2014 Basewide Groundwater Monitoring Sampling and Analysis Plan, Volume I-Long Term Monitoring Optimization Work Plan. Prepared for Air Force Civil Engineering Center, Installation Support Team Edwards Air Force Base, California

URS Corporation (2011). *Draft Report. Jurisdictional Streambeds Review for the Oro Verde Solar Project*. Prepared for Fotowatio Renewable Ventures. Kern County, California.

United States Army Corps of Engineers (USACE)

2013 *Approved Jurisdictional Determination Form for the Los Angeles District, Sunlight Partners Solar Array Project*, SPL-2011-01084-SLP, June 7, 2013.

United States Environmental Protection Agency (USEPA)

2016 *Green Book Nonattainment Areas*. June 17, 2016. https://www3.epa.gov/airquality/greenbook/. Accessed June 2016.

2016 *National Ambient Air Quality Standards (NAAQS)*. March 29, 2016. http://www.epa.gov/air/criteria.html. Accessed June 2016.

2016 *Regulatory Initiatives*. February 23, 2016. http://epa.gov/climatechange/EPAactivities/regulatory-initiatives.html. Accessed June 2016.

United States Fish and Wildlife Services (USFWS)

2000 *Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed and Candidate Plants.*

(1918). *Migratory Bird Treaty Act.* Section 16 of the U.S. Code (703-712), as amended 1989.

2010 *Preparing for any Action that may Occur within the Range of the Mojave Desert Tortoise* (*Gopherus Agassizii*).

Wade, S. A. and Hector, S. M.
1989 Archaeological Testing and National Register Evaluation of Site LAN-1316 (EAFB-835), Edwards Air Force Base, California. Prepared for the Department of the Air Forces, AFFTC/DEV, Edwards Air Force Base, California

6.0 LIST OF AGENCIES AND ORGANIZATIONS TO WHOM COPIES OF THE ENVIRONMENTAL ASSESSMENT ARE SENT

AFTC Technical Library
812 TSS/ENTL
Edwards AFB, CA 93524

Edwards Base Library
412 FSS/FSDL
5 West Yeager Blvd., Building 2665
Edwards AFB, CA 93524

Palmdale City Library
E. Palmdale Boulevard
Palmdale, CA 93550

Los Angeles County Library
Lancaster Branch
601 W. Lancaster Boulevard
Lancaster, CA 93534

Kern County Library
Wanda Kirk Branch
3611 Rosamond Boulevard
Rosamond, CA 93560

Kern County Library
Mojave Branch
16916-1/2 Highway 14
Mojave, CA 93501

Kern County Library
Boron Branch
26967 20 Mule Team Road
Boron, CA 93516

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Fish and Wildlife Service, Carlsbad Field Office
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Carlsbad, CA 92008

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2501 Lake Tahoe Boulevard
South Lake Tahoe, CA 96150

Tejon Indian Tribe
1731 Hasti-Acres Drive, Suite 108
Bakersfield, CA 93309

San Manuel Band of Mission Indians
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8.0 ACRONYMS AND ABBREVIATIONS

ACECs	Areas of Critical Environmental Concern
ADP	Area Development Plan
AF	Air Force
AFB	Air Force Base
AFI	Air Force Instruction
AFRC	Armstrong Flight Research Center
AFRL	Air Force Research Laboratory
AFTC	Air Force Test Center
AICUZ	Air Installation Compatible Use Zone
AMSL	Above mean sea level
APCD	Air Pollution Control District
APE	Area of Potential Effect
APZ	accident potential zones
AQMD	Air Quality Management District
ARB	Air Resources Board
AVAQMD	Antelope Valley Air Quality Management District
AVEK	Antelope Valley East Kern (Water Agency)
BCC	birds of conservation concern
bgs	below ground surface
BFEs	Base Flood Elevations
BLM	U.S. Bureau of Land Management
BP	Before present
BX	base exchange
°C	Celsius
CAA	Clean Air Act
CAAQS	California Ambient Air Quality Standards
Cal-EPA	California Environmental Protection Agency
CalEEMod	California Emissions Estimator Model
CalOSHA	California Federal Occupational Safety and Health Act
Caltrans	California Department of Transportation
CARB	California Air Resources Board
CATM	Combat Arms Training Maintenance
CCR	California Code of Regulations
CDC	child development center
CDFG	California Terrestrial Communities
CDFW	California Department of Fish and Wildlife
CEG	Civil Engineer Group
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulation
CH_4	Methane
CHL	California Historic Landmarks

CNEL	Community Noise Equivalent Level
CNPS	California Native Plant Society
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_{2e}	Carbon dioxide equivalent mass
CRHP	California Registration of Historic Places
CRP	Compliance Restoration Program
CRWQCB	California Regional Water Quality Control Board
CZ	clear zones
dB	decibel
DoD	Department of Defense
DoDI	Department of Defense Instruction
DNAPLs	dense, non-aqueous phase liquids
DNL	day/night equivalent A-weighted noise level (also L_{dn})
DRECP	Desert Renewable Energy Conservation Plan
DTSC	Department of Toxic Substances Control
DWMAs	Desert Wildlife Management Areas
EA	Environmental Assessment
ECP	Entry Control Point
EIAP	Environmental Impact Analysis Process
EKAPCD	Eastern Kern Air Pollution Control District
EO	Executive Order
EOD	explosive ordnance disposal
EPA	United States Environmental Protection Agency (USEPA)
ERP	Environmental Restoration Program
ESQD	explosive safety quantity distance
EUL	enhanced use lease
412 TW	412th Test Wing
412 CS	412th Communications Squadron
FEMA	Federal Emergency Management Agency
FFA	Federal Facilities Agreement
FFCA	Federal Facility Compliance Act of 1992
FY	fiscal year
GHG	Greenhouse gas
GIS	Geographic Information Systems
GPD	gallons per day
GWP	Global warming potential
H_2S	hydrogen sulfide
HFCs	Hydrofluorocarbons
HWMP	Hazardous Waste Management Plan
HW	hazardous waste
ICRMP	Integrated Cultural Resources Management Plan
IDP	Installation Development Plan
INRMP	Integrated Natural Resources Management Plan
JP-8	Jet Propellant 8
JPL	Jet Propulsion Laboratory

kV	kilovolt
kW	kilowatts
LOS	Level of Service
MBAL	Main Base Active Landfill
MBTA	Migratory Bird Treaty Act
MCF	million cubic feet
MDAB	Mojave Desert Air Basin
MDAQMD	Mojave Desert Air Quality Management District
$\mu g/m^3$	Micrograms per cubic meter
MGD	million gallons per day
MM	minimization measure
mph	miles per hour
MSL	Mean sea level
$MTCO_{2e}$	Metric tons of CO_2-equivalent mass
MVA	million volt-ampere
MW	megawatts
N/A	Not applicable
NAAQS	National Ambient Air Quality Standards
NAHC	Native American Heritage Commission
NASA	National Aeronautical Space Administration
NEPA	National Environmental Policy Act
NHM	Natural History Museum
NHPA	National Historic Preservation Act of 1966
NO	Nitrogen monoxide
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
N_2O	Nitrous oxide
NPDES	National Pollutant Discharge Elimination System
NRCS	National Resources Conservation Service
NRHP	National Register of Historic Places
O_3	Ozone
O&M	operation and maintenance
ORV	off-road vehicle
OSHA	Federal Occupational Safety and Health Act
OU	Operable Unit
Pb	Lead
PCE	perchloroethene
PFCs	Perfluorocarbons
PG&E	Pacific Gas & Electric
$PM_{2.5}$	Particulate matter less than 2.5 microns in diameter
PM_{10}	Respirable particulate matter less than 10 microns in diameter
ppb	Parts per billion
ppm	Parts per million
RCRA	Resource Conservation and Recovery Act
RDT&E	research, development, test and evaluation
RI	Remedial Investigation

ROD	Record of Decision
RPIR	real property inventory requirements
SARA	Superfund Amendments and Reauthorization Act
SCAQMD	South Coast Air Quality Management District
SCE	Southern California Edison
SDI	Sustainability Development Indicators
SDZ	Safety Distance Zone
SEA	Significant Ecological Areas
SFS	Security Forces Squadron
SF_6	Sulfur hexafluoride
SHPO	State Historic Preservation Office
SO_2	Sulfur dioxide
SO_4	Sulfates
SRM	sustainment, restoration and modernization
SSC	species of special concern
SWPPP	Storm Water Pollution Prevention Plan
TCE	trichloroethene
the base	Edwards AFB
TLF	temporary lodging facilities
TOSCA	Toxic Substance Control Act
TPS	Test Pilot School
tpy	Tons per year
UFC	Unified Facilities Criteria
USACE	United States Army Corps of Engineers
USAF	United States Air Force
USCG	United States Coast Guard
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
VOC	Volatile Organic Compounds
VOQ	visiting officer quarters
VQI	visiting quarters
WEMO	West Mojave Plan
WWTP	wastewater treatment plant

APPENDIX A

PUBLIC COMMENTS AND RESPONSES TO THE DRAFT EA

Relevant federal and state resource agencies, Native American tribes, and local document repositories on the project mailing list have been sent notification on the Proposed Action and Alternatives. The Draft EA was filed with the California Office of Planning and Research (State Clearinghouse) for distribution to appropriate State and regional agencies for review and comment. One letter from the RWQCB was received. This letter, as well as the response to the letter, are provided in this appendix.

May 5, 2017

File: Environmental Doc Review, San Bernardino, Kern, and Los Angeles Counties

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Comments on the Draft Environmental Assessment for Implementation of the Installation Development Plan at Edwards Air Force Base, Kern County, State Clearinghouse No. 2017044001

California Regional Water Quality Control Board, Lahontan Region (Water Board) staff received the Environmental Assessment and Finding of No Significant Impact (EA/FONSI) on the above-referenced plan (Plan) on April 18, 2017. The EA/FONSI was prepared by the United States Air Force Department of Defense (USAF) to evaluate potential impacts and required mitigation associated with implementation of the proposed Installation Development Plan. The Plan is a planning tool for demolition, construction and modification of facilities and infrastructure identified at EAFB as critical in supporting current and projected mission needs; subsequent and focused environmental review will occur as individual projects are proposed to implement elements of the Plan. Alternatives evaluated included high intensity development, basic maintenance, and no action. The EA/FONSI was circulated by the USAF in compliance with the provisions of NEPA in order to solicit input and considerations for potential additional environmental analysis and compliance with any other applicable regulations.

Water Board staff, acting as a responsible agency, is providing these comments to specify the scope and content of the environmental information germane to our statutory responsibilities pursuant to California Environmental Quality Act (CEQA) Guidelines, California Code of Regulations, title 14, section 15096. We thank the USAF for considering our comments and our position with respect to protecting and maintaining water quality in the Lahontan Region. Our comments are outlined below.

Water Board's Authority

All groundwater and surface waters are considered waters of the State. Surface waters include streams, lakes, ponds, and wetlands, and may be ephemeral, intermittent, or perennial. All waters of the State are protected under California law. State law assigns

responsibility for protection of water quality in the Lahontan Region to the Lahontan Water Board. Some waters of the State are also waters of the U.S. The Federal Clean Water Act (CWA) provides additional protection for those waters of the State that are also waters of the U.S.

The *Water Quality Control Plan for the Lahontan Region* (Basin Plan) contains policies that the Water Board uses with other laws and regulations to protect the quality of waters of the State within the Lahontan Region. The Basin Plan sets forth water quality standards for surface water and groundwater of the Region, which include designated beneficial uses as well as narrative and numerical objectives which must be maintained or attained to protect those uses. The Basin Plan can be accessed via the Water Board's web site at http://www.waterboards.ca.gov/lahontan/water_issues/programs/basin_plan/references.shtml.

Specific Issues to be Considered

We recommend the following be included as part of the proposed Plan and considered in subsequent project-level environmental review.

1. The State Water Board or the Regional Water Board (collectively referred to as Water Boards) may need to issue discretionary permits for implementation of the Plan, we request that project-level environmental documents prepared in association to the Plan comply with and satisfy the requirements of both NEPA and CEQA. The Water Boards cannot take a discretionary action or issue a permit until CEQA has been satisfied.

2. Plan areas may include marked (blue line) and unmarked surface waters, all of which are waters of the State. Surface waters include, but are not limited to, drainages, streams, washes, ponds, pools, or wetlands, and may be permanent or intermittent. Waters of the State may include waters determined to be jurisdictional waters of the U.S. by the U.S. Army Corps of Engineers (USACE).

3. The beneficial uses of water resources in the Lahontan Region are listed either by watershed (for surface waters) or by groundwater basin (for groundwater) in Chapter 2 of the Basin Plan. Project-level environmental documents should identify and list the beneficial uses of the water resources within the Plan area and include an analysis of the potential impacts to water quality and hydrology with respect to those beneficial uses.

4. Water quality objectives and standards, both numerical and narrative, for all waters of the State within the Lahontan Region, including surface waters and groundwater, are outlined in Chapter 3 of the Basin Plan. Water quality objectives and standards are intended to protect the public health and welfare, and to maintain or enhance water quality in relation to the existing and/or potential beneficial uses of the water. It is these objectives and standards that should be used when evaluating thresholds of significance for potential impacts.

5. As noted above, drainages are considered surface waters. Project-level environmental documents should provide specific information regarding impacts to surface waters, specifically the re-routing of drainages and other waters, placement and sizing of any culverts, and any mitigation that may be required for proposed impacts. The environmental document should quantify these impacts and discuss the purpose of the project, need for surface water disturbance, and propose alternatives (in order to first avoid impacts and minimize disturbances, and propose mitigation for unavoidable impacts). We request that measures be incorporated into projects to avoid surface waters and provide buffer zones where possible. If a proposed project impacts and alters drainages, then we request that the project proponent obtain permit coverage and that the project be designed such that it would maintain existing hydrologic features and patterns to the extent feasible. We encourage early consultation with the Water Board staff prior to commencement of a project.

6. The Water Board requires that impacts to water resources be avoided where feasible and minimized to the extent practical. Compensatory mitigation will be required for all unavoidable permanent impacts to surface water resources. Water Board staff coordinate all mitigation requirements with staff from other federal and state regulatory agencies, including the USACE and the California Department of Fish and Wildlife. In determining appropriate mitigation ratios for impacts to waters of the State, Water Board staff considers Basin Plan requirements (minimum 1.5:1 mitigation ratio for impacts to wetlands) and utilizes *12501-SPD Regulatory Program Standard Operating Procedure for Determination of Mitigation Ratios*, published December 2012 by the USACE, South Pacific Division.

7. Best Management Practices (BMPs) are used to reduce pollutants in runoff to waters of the State. An adequate combination of sediment and erosion control BMPs shall be implemented during active and post-construction phases of a project to manage storm water and minimize impacts from storm water runoff, such as erosion. The environmental document must specifically describe BMPs and their role in mitigation of project impacts. Keep in mind that mitigation must protect functions and values, and that measures must be identified and discussed in the environmental document. For more information, see the Basin Plan, which can be accessed via the Water Board's web site (http://www.waterboards.ca.gov/lahontan/water_issues/programs/basin_plan/references.shtml).

8. Equipment staging areas should be sited in upland areas outside stream channels and other surface waters within a project area. Buffer areas should be identified and exclusion fencing used to protect the water resource and prevent unauthorized vehicles or equipment from entering or otherwise disturbing the surface waters. Equipment should use existing roadways to the extent feasible.

Permitting Requirements for Individual Projects

A number of activities implemented by individual projects associated with the proposed Plan have the potential to impact waters of the State and, therefore, may require permits issued

by either the State Water Resources Control Board (State Water Board) or Lahontan Water Board. The required permits may include the following.

1. Streambed alteration and/or discharge of fill material to a surface water may require a CWA, section 401 water quality certification for impacts to federal waters (waters of the U.S.), or dredge and fill waste discharge requirements for impacts to non-federal waters (waters of the State only), both issued by the Lahontan Water Board or State Water Board.

2. Land disturbance of more than 1 acre may require a CWA, section 402(p) storm water permit, including a *National Pollutant Discharge Elimination System (NPDES) General Construction Storm Water Permit*, Water Quality Order (WQO) 2009-0009-DWQ, obtained from the State Water Board, or individual storm water permit obtained from the Lahontan Water Board.

3. Water diversion and/or dewatering activities may be subject to discharge and monitoring requirements under either NPDES General Permit, Limited Threat Discharges to Surface Waters, Board Order R6T-2014-0049, or General Waste Discharge Requirements for Discharges to Land with a Low Threat to Water Quality, WQO-2003-0003, both issued by the Lahontan Water Board.

Please be advised of the permits that may be required for individual projects that may be implemented under the proposed Plan, as outlined above. The specific activities that may trigger these permitting actions should be identified in the appropriate sections of the environmental document. Should Plan implementation result in activities that trigger these permitting actions, the project proponent must consult with Water Board staff. Information regarding these permits, including application forms, can be downloaded from our web site at http://www.waterboards.ca.gov/lahontan/.

Thank you for the opportunity to comment on the EA/FONSI. If you have any questions regarding this letter, please contact me at (760) 241-7333, (christina.guerra@waterboards.ca.gov) or Patrice Copeland, Supervising Engineering Geologist, at (760)241-7404 (patrice.copeland@waterboards.ca.gov).

Christina Guerra
Engineering Geologist

cc: State Clearinghouse (SCH 2017044001), stateclearinghouse@opr.ca.gov
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Kevin Depies, DTSC, kevin.depies@dtsc.ca.gov
Dan Waligora, CDFW, dan.waligora@wildlife.ca.gov

LETTER FROM LAHONTAN REGIONAL WATER QUALITY CONTROL BOARD, DATED MAY 5, 2017

California Water Boards
Lahontan Regional Water Quality Control Board
2501 Lake Tahoe Boulevard
South Lake Tahoe, California 96150
Christina Guerra
Engineering Geologist

RESPONSE TO LETTER

Thank you for your response to our environmental assessment. We have reviewed and taken your inputs into consideration.

This Installation Development Plan (IDP) EA was conducted as required by the National Environmental Policy Act (NEPA), Sec. 101 [42 USC 4331] and CEQ Regulations (40 CFR Parts 1500-1508) which directs that NEPA be conducted on Federal land use plans. The IDP is a Federal plan that considers land use and therefore, NEPA must be conducted on it. Though there are actual projects noted in the IDP EA, the projects considered in this EA are not currently being actively pursued, but were developed solely as "worst case" types of projects that would be representative of the types of actions that could occur in each IDP district. As such, any future actual project, including those currently called out in the IDP EA, would require its own site-specific NEPA. In the process of conducting NEPA on a project, all water considerations, including the need for any required permits, would be taken into account.

APPENDIX B

INSTALLATION DEVELOPMENT PLAN

DOCUMENT IS NOT ATTACHED TO THE EA BECAUSE IT IS AVAILABLE FOR OFFICIAL USE ONLY (FOUO)

APPENDIX C
AIR QUALITY CALCULATIONS

Edwards AFB IDP1

Mojave Desert Air Basin, Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
General Office Building	159.00	1000sqft	3.65	159,000.00	0
Parking Lot	223.15	1000sqft	5.12	223,150.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.6	**Precipitation Freq (Days)**	31
Climate Zone	7			**Operational Year**	2018
Utility Company	Southern California Edison				
CO2 Intensity (lb/MWhr)	630.89	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use -

Construction Phase - Total construction completed per year. Coating operations estimated to occur over a 30 period spread over posssibly multiple sites.

Off-road Equipment - Compressor operating hrs reduced and architectural coating phase extended to reduce emissions.

Energy Mitigation -

Construction Off-road Equipment Mitigation - Equipment with Tier 2 engines

Table Name	Column Name	Default Value	New Value
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstructionPhase	NumDays	20.00	30.00
tblConstructionPhase	NumDays	230.00	170.00
tblConstructionPhase	PhaseEndDate	1/12/2018	12/29/2017
tblConstructionPhase	PhaseStartDate	12/2/2017	11/20/2017
tblOffRoadEquipment	UsageHours	6.00	4.00
tblProjectCharacteristics	OperationalYear	2014	2018
tblTripsAndVMT	HaulingTripNumber	0.00	331.00

2.0 Emissions Summary

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2017	2.4270	4.0254	4.2265	6.0200e-003	0.3085	0.2305	0.5389	0.1237	0.2153	0.3390	0.0000	518.8524	518.8524	0.0873	0.0000	520.6847
Total	**2.4270**	**4.0254**	**4.2265**	**6.0200e-003**	**0.3085**	**0.2305**	**0.5389**	**0.1237**	**0.2153**	**0.3390**	**0.0000**	**518.8524**	**518.8524**	**0.0873**	**0.0000**	**520.6847**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2017	2.4270	4.0254	4.2265	6.0200e-003	0.2187	0.2305	0.4491	0.0772	0.2153	0.2926	0.0000	518.8520	518.8520	0.0873	0.0000	520.6843
Total	**2.4270**	**4.0254**	**4.2265**	**6.0200e-003**	**0.2187**	**0.2305**	**0.4491**	**0.0772**	**0.2153**	**0.2926**	**0.0000**	**518.8520**	**518.8520**	**0.0873**	**0.0000**	**520.6843**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**29.11**	**0.00**	**16.66**	**37.55**	**0.00**	**13.70**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	1.6848	3.0000e-005	3.5600e-003	0.0000		1.0000e-005	1.0000e-005		1.0000e-005	1.0000e-005	0.0000	6.8300e-003	6.8300e-003	2.0000e-005	0.0000	7.2200e-003
Energy	0.0155	0.1405	0.1180	8.4000e-004		0.0107	0.0107		0.0107	0.0107	0.0000	715.1429	715.1429	0.0288	8.1500e-003	718.2739
Mobile	0.9910	2.7105	12.8684	0.0191	1.2054	0.0420	1.2474	0.3224	0.0386	0.3611	0.0000	1,453.0514	1,453.0514	0.0576	0.0000	1,454.2601
Waste						0.0000	0.0000		0.0000	0.0000	30.0163	0.0000	30.0163	1.7739	0.0000	67.2684
Water						0.0000	0.0000		0.0000	0.0000	8.9655	160.3677	169.3332	0.9282	0.0233	196.0388
Total	**2.6912**	**2.8511**	**12.9900**	**0.0200**	**1.2054**	**0.0526**	**1.2581**	**0.3224**	**0.0493**	**0.3717**	**38.9818**	**2,328.5688**	**2,367.5505**	**2.7885**	**0.0314**	**2,435.8485**

2.2 Overall Operational

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	1.5732	3.0000e-005	3.5600e-003	0.0000		1.0000e-005	1.0000e-005		1.0000e-005	1.0000e-005	0.0000	6.8300e-003	6.8300e-003	2.0000e-005	0.0000	7.2200e-003
Energy	0.0155	0.1405	0.1180	8.4000e-004		0.0107	0.0107		0.0107	0.0107	0.0000	715.1429	715.1429	0.0288	8.1500e-003	718.2739
Mobile	0.9714	2.5750	12.4346	0.0180	1.1276	0.0394	1.1670	0.3016	0.0362	0.3379	0.0000	1,362.7859	1,362.7859	0.0543	0.0000	1,363.9267
Waste						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Water						0.0000	0.0000		0.0000	0.0000	7.1724	135.9485	143.1209	0.7428	0.0187	164.5039
Total	**2.5601**	**2.7156**	**12.5562**	**0.0188**	**1.1276**	**0.0501**	**1.1777**	**0.3016**	**0.0469**	**0.3486**	**7.1724**	**2,213.8841**	**2,221.0565**	**0.8259**	**0.0268**	**2,246.7117**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**4.87**	**4.75**	**3.34**	**5.91**	**6.46**	**4.88**	**6.39**	**6.46**	**4.81**	**6.24**	**81.60**	**4.93**	**6.19**	**70.38**	**14.67**	**7.76**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Demolition	Demolition	1/1/2017	1/27/2017	5	20	
2	Site Preparation	Site Preparation	1/28/2017	2/10/2017	5	10	
3	Grading	Grading	2/11/2017	3/10/2017	5	20	
4	Building Construction	Building Construction	3/11/2017	11/3/2017	5	170	
5	Paving	Paving	11/4/2017	12/1/2017	5	20	
6	Architectural Coating	Architectural Coating	11/20/2017	12/29/2017	5	30	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 10

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 248,542; Non-Residential Outdoor: 82,847 (Architectural Coating – sqft)

<u>OffRoad Equipment</u>

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Demolition	Concrete/Industrial Saws	1	8.00	81	0.73
Demolition	Excavators	3	8.00	162	0.38
Demolition	Rubber Tired Dozers	2	8.00	255	0.40
Site Preparation	Rubber Tired Dozers	3	8.00	255	0.40
Site Preparation	Tractors/Loaders/Backhoes	4	8.00	97	0.37
Grading	Excavators	1	8.00	162	0.38
Grading	Graders	1	8.00	174	0.41
Grading	Rubber Tired Dozers	1	8.00	255	0.40
Grading	Tractors/Loaders/Backhoes	3	8.00	97	0.37
Building Construction	Cranes	1	7.00	226	0.29
Building Construction	Forklifts	3	8.00	89	0.20
Building Construction	Generator Sets	1	8.00	84	0.74
Building Construction	Tractors/Loaders/Backhoes	3	7.00	97	0.37
Building Construction	Welders	1	8.00	46	0.45
Paving	Pavers	2	8.00	125	0.42
Paving	Paving Equipment	2	8.00	130	0.36
Paving	Rollers	2	8.00	80	0.38
Architectural Coating	Air Compressors	1	4.00	78	0.48

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Demolition	6	15.00	0.00	67.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Site Preparation	7	18.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Grading	6	15.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction	9	145.00	63.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Paving	6	15.00	0.00	331.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Architectural Coating	1	29.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

Use Cleaner Engines for Construction Equipment

Water Exposed Area

Clean Paved Roads

3.2 Demolition - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					7.3800e-003	0.0000	7.3800e-003	1.1200e-003	0.0000	1.1200e-003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0405	0.4270	0.3389	4.0000e-004		0.0213	0.0213		0.0198	0.0198	0.0000	36.6182	36.6182	0.0101	0.0000	36.8292
Total	**0.0405**	**0.4270**	**0.3389**	**4.0000e-004**	**7.3800e-003**	**0.0213**	**0.0286**	**1.1200e-003**	**0.0198**	**0.0209**	**0.0000**	**36.6182**	**36.6182**	**0.0101**	**0.0000**	**36.8292**

3.2 Demolition - 2017

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	7.1000e-004	6.1200e-003	0.0102	2.0000e-005	5.8000e-004	1.6000e-004	7.4000e-004	1.6000e-004	1.5000e-004	3.1000e-004	0.0000	2.1457	2.1457	1.0000e-005	0.0000	2.1459
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	5.2000e-004	8.8000e-004	8.2800e-003	1.0000e-005	1.2100e-003	1.0000e-005	1.2200e-003	3.2000e-004	1.0000e-005	3.3000e-004	0.0000	1.0332	1.0332	6.0000e-005	0.0000	1.0346
Total	**1.2300e-003**	**7.0000e-003**	**0.0185**	**3.0000e-005**	**1.7900e-003**	**1.7000e-004**	**1.9600e-003**	**4.8000e-004**	**1.6000e-004**	**6.4000e-004**	**0.0000**	**3.1788**	**3.1788**	**7.0000e-005**	**0.0000**	**3.1805**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					3.3200e-003	0.0000	3.3200e-003	5.0000e-004	0.0000	5.0000e-004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0405	0.4270	0.3389	4.0000e-004		0.0213	0.0213		0.0198	0.0198	0.0000	36.6182	36.6182	0.0101	0.0000	36.8291
Total	**0.0405**	**0.4270**	**0.3389**	**4.0000e-004**	**3.3200e-003**	**0.0213**	**0.0246**	**5.0000e-004**	**0.0198**	**0.0203**	**0.0000**	**36.6182**	**36.6182**	**0.0101**	**0.0000**	**36.8291**

3.2 Demolition - 2017

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	7.1000e-004	6.1200e-003	0.0102	2.0000e-005	5.8000e-004	1.6000e-004	7.4000e-004	1.6000e-004	1.5000e-004	3.1000e-004	0.0000	2.1457	2.1457	1.0000e-005	0.0000	2.1459
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	5.2000e-004	8.8000e-004	8.2800e-003	1.0000e-005	1.2100e-003	1.0000e-005	1.2200e-003	3.2000e-004	1.0000e-005	3.3000e-004	0.0000	1.0332	1.0332	6.0000e-005	0.0000	1.0346
Total	**1.2300e-003**	**7.0000e-003**	**0.0185**	**3.0000e-005**	**1.7900e-003**	**1.7000e-004**	**1.9600e-003**	**4.8000e-004**	**1.6000e-004**	**6.4000e-004**	**0.0000**	**3.1788**	**3.1788**	**7.0000e-005**	**0.0000**	**3.1805**

3.3 Site Preparation - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.0903	0.0000	0.0903	0.0497	0.0000	0.0497	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0242	0.2588	0.1970	2.0000e-004		0.0138	0.0138		0.0127	0.0127	0.0000	18.1577	18.1577	5.5600e-003	0.0000	18.2745
Total	**0.0242**	**0.2588**	**0.1970**	**2.0000e-004**	**0.0903**	**0.0138**	**0.1041**	**0.0497**	**0.0127**	**0.0623**	**0.0000**	**18.1577**	**18.1577**	**5.5600e-003**	**0.0000**	**18.2745**

3.3 Site Preparation - 2017

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	3.1000e-004	5.3000e-004	4.9700e-003	1.0000e-005	7.3000e-004	1.0000e-005	7.3000e-004	1.9000e-004	0.0000	2.0000e-004	0.0000	0.6199	0.6199	4.0000e-005	0.0000	0.6207
Total	**3.1000e-004**	**5.3000e-004**	**4.9700e-003**	**1.0000e-005**	**7.3000e-004**	**1.0000e-005**	**7.3000e-004**	**1.9000e-004**	**0.0000**	**2.0000e-004**	**0.0000**	**0.6199**	**0.6199**	**4.0000e-005**	**0.0000**	**0.6207**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.0407	0.0000	0.0407	0.0223	0.0000	0.0223	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0242	0.2588	0.1970	2.0000e-004		0.0138	0.0138		0.0127	0.0127	0.0000	18.1577	18.1577	5.5600e-003	0.0000	18.2745
Total	**0.0242**	**0.2588**	**0.1970**	**2.0000e-004**	**0.0407**	**0.0138**	**0.0544**	**0.0223**	**0.0127**	**0.0350**	**0.0000**	**18.1577**	**18.1577**	**5.5600e-003**	**0.0000**	**18.2745**

3.3 Site Preparation - 2017

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	3.1000e-004	5.3000e-004	4.9700e-003	1.0000e-005	7.3000e-004	1.0000e-005	7.3000e-004	1.9000e-004	0.0000	2.0000e-004	0.0000	0.6199	0.6199	4.0000e-005	0.0000	0.6207
Total	**3.1000e-004**	**5.3000e-004**	**4.9700e-003**	**1.0000e-005**	**7.3000e-004**	**1.0000e-005**	**7.3000e-004**	**1.9000e-004**	**0.0000**	**2.0000e-004**	**0.0000**	**0.6199**	**0.6199**	**4.0000e-005**	**0.0000**	**0.6207**

3.4 Grading - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.0655	0.0000	0.0655	0.0337	0.0000	0.0337	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0346	0.3598	0.2538	3.0000e-004		0.0204	0.0204		0.0188	0.0188	0.0000	27.6117	27.6117	8.4600e-003	0.0000	27.7893
Total	**0.0346**	**0.3598**	**0.2538**	**3.0000e-004**	**0.0655**	**0.0204**	**0.0859**	**0.0337**	**0.0188**	**0.0524**	**0.0000**	**27.6117**	**27.6117**	**8.4600e-003**	**0.0000**	**27.7893**

3.4 Grading - 2017

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	5.2000e-004	8.8000e-004	8.2800e-003	1.0000e-005	1.2100e-003	1.0000e-005	1.2200e-003	3.2000e-004	1.0000e-005	3.3000e-004	0.0000	1.0332	1.0332	6.0000e-005	0.0000	1.0346
Total	**5.2000e-004**	**8.8000e-004**	**8.2800e-003**	**1.0000e-005**	**1.2100e-003**	**1.0000e-005**	**1.2200e-003**	**3.2000e-004**	**1.0000e-005**	**3.3000e-004**	**0.0000**	**1.0332**	**1.0332**	**6.0000e-005**	**0.0000**	**1.0346**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.0295	0.0000	0.0295	0.0152	0.0000	0.0152	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0346	0.3598	0.2538	3.0000e-004		0.0204	0.0204		0.0188	0.0188	0.0000	27.6117	27.6117	8.4600e-003	0.0000	27.7893
Total	**0.0346**	**0.3598**	**0.2538**	**3.0000e-004**	**0.0295**	**0.0204**	**0.0499**	**0.0152**	**0.0188**	**0.0339**	**0.0000**	**27.6117**	**27.6117**	**8.4600e-003**	**0.0000**	**27.7893**

3.4 Grading - 2017

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	5.2000e-004	8.8000e-004	8.2800e-003	1.0000e-005	1.2100e-003	1.0000e-005	1.2200e-003	3.2000e-004	1.0000e-005	3.3000e-004	0.0000	1.0332	1.0332	6.0000e-005	0.0000	1.0346
Total	**5.2000e-004**	**8.8000e-004**	**8.2800e-003**	**1.0000e-005**	**1.2100e-003**	**1.0000e-005**	**1.2200e-003**	**3.2000e-004**	**1.0000e-005**	**3.3000e-004**	**0.0000**	**1.0332**	**1.0332**	**6.0000e-005**	**0.0000**	**1.0346**

3.5 Building Construction - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.2637	2.2445	1.5410	2.2800e-003		0.1514	0.1514		0.1422	0.1422	0.0000	203.5572	203.5572	0.0501	0.0000	204.6093
Total	**0.2637**	**2.2445**	**1.5410**	**2.2800e-003**		**0.1514**	**0.1514**		**0.1422**	**0.1422**	**0.0000**	**203.5572**	**203.5572**	**0.0501**	**0.0000**	**204.6093**

3.5 Building Construction - 2017

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0650	0.3960	0.9347	1.1800e-003	0.0345	8.7700e-003	0.0433	9.8100e-003	8.0600e-003	0.0179	0.0000	105.3054	105.3054	6.5000e-004	0.0000	105.3190
Worker	0.0424	0.0726	0.6805	1.1800e-003	0.0994	7.3000e-004	0.1001	0.0264	6.7000e-004	0.0271	0.0000	84.8940	84.8940	5.3300e-003	0.0000	85.0060
Total	**0.1074**	**0.4685**	**1.6151**	**2.3600e-003**	**0.1339**	**9.5000e-003**	**0.1434**	**0.0362**	**8.7300e-003**	**0.0449**	**0.0000**	**190.1994**	**190.1994**	**5.9800e-003**	**0.0000**	**190.3250**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.2637	2.2445	1.5410	2.2800e-003		0.1514	0.1514		0.1422	0.1422	0.0000	203.5570	203.5570	0.0501	0.0000	204.6091
Total	**0.2637**	**2.2445**	**1.5410**	**2.2800e-003**		**0.1514**	**0.1514**		**0.1422**	**0.1422**	**0.0000**	**203.5570**	**203.5570**	**0.0501**	**0.0000**	**204.6091**

3.5 Building Construction - 2017

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0650	0.3960	0.9347	1.1800e-003	0.0345	8.7700e-003	0.0433	9.8100e-003	8.0600e-003	0.0179	0.0000	105.3054	105.3054	6.5000e-004	0.0000	105.3190
Worker	0.0424	0.0726	0.6805	1.1800e-003	0.0994	7.3000e-004	0.1001	0.0264	6.7000e-004	0.0271	0.0000	84.8940	84.8940	5.3300e-003	0.0000	85.0060
Total	**0.1074**	**0.4685**	**1.6151**	**2.3600e-003**	**0.1339**	**9.5000e-003**	**0.1434**	**0.0362**	**8.7300e-003**	**0.0449**	**0.0000**	**190.1994**	**190.1994**	**5.9800e-003**	**0.0000**	**190.3250**

3.6 Paving - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0191	0.2030	0.1473	2.2000e-004		0.0114	0.0114		0.0105	0.0105	0.0000	20.6934	20.6934	6.3400e-003	0.0000	20.8266
Paving	6.7100e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0258**	**0.2030**	**0.1473**	**2.2000e-004**		**0.0114**	**0.0114**		**0.0105**	**0.0105**	**0.0000**	**20.6934**	**20.6934**	**6.3400e-003**	**0.0000**	**20.8266**

3.6 Paving - 2017

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	3.5300e-003	0.0302	0.0506	1.2000e-004	2.8500e-003	8.2000e-004	3.6700e-003	7.8000e-004	7.5000e-004	1.5300e-003	0.0000	10.6001	10.6001	6.0000e-005	0.0000	10.6014
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	5.2000e-004	8.8000e-004	8.2800e-003	1.0000e-005	1.2100e-003	1.0000e-005	1.2200e-003	3.2000e-004	1.0000e-005	3.3000e-004	0.0000	1.0332	1.0332	6.0000e-005	0.0000	1.0346
Total	**4.0500e-003**	**0.0311**	**0.0589**	**1.3000e-004**	**4.0600e-003**	**8.3000e-004**	**4.8900e-003**	**1.1000e-003**	**7.6000e-004**	**1.8600e-003**	**0.0000**	**11.6333**	**11.6333**	**1.2000e-004**	**0.0000**	**11.6359**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0191	0.2030	0.1473	2.2000e-004		0.0114	0.0114		0.0105	0.0105	0.0000	20.6934	20.6934	6.3400e-003	0.0000	20.8265
Paving	6.7100e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0258**	**0.2030**	**0.1473**	**2.2000e-004**		**0.0114**	**0.0114**		**0.0105**	**0.0105**	**0.0000**	**20.6934**	**20.6934**	**6.3400e-003**	**0.0000**	**20.8265**

3.6 Paving - 2017

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	3.5300e-003	0.0302	0.0506	1.2000e-004	2.8500e-003	8.2000e-004	3.6700e-003	7.8000e-004	7.5000e-004	1.5300e-003	0.0000	10.6001	10.6001	6.0000e-005	0.0000	10.6014
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	5.2000e-004	8.8000e-004	8.2800e-003	1.0000e-005	1.2100e-003	1.0000e-005	1.2200e-003	3.2000e-004	1.0000e-005	3.3000e-004	0.0000	1.0332	1.0332	6.0000e-005	0.0000	1.0346
Total	**4.0500e-003**	**0.0311**	**0.0589**	**1.3000e-004**	**4.0600e-003**	**8.3000e-004**	**4.8900e-003**	**1.1000e-003**	**7.6000e-004**	**1.8600e-003**	**0.0000**	**11.6333**	**11.6333**	**1.2000e-004**	**0.0000**	**11.6359**

3.7 Architectural Coating - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Archit. Coating	1.9200					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	3.3200e-003	0.0219	0.0187	3.0000e-005		1.7300e-003	1.7300e-003		1.7300e-003	1.7300e-003	0.0000	2.5533	2.5533	2.7000e-004	0.0000	2.5589
Total	**1.9233**	**0.0219**	**0.0187**	**3.0000e-005**		**1.7300e-003**	**1.7300e-003**		**1.7300e-003**	**1.7300e-003**	**0.0000**	**2.5533**	**2.5533**	**2.7000e-004**	**0.0000**	**2.5589**

3.7 Architectural Coating - 2017

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	1.5000e-003	2.5600e-003	0.0240	4.0000e-005	3.5100e-003	3.0000e-005	3.5300e-003	9.3000e-004	2.0000e-005	9.6000e-004	0.0000	2.9963	2.9963	1.9000e-004	0.0000	3.0002
Total	**1.5000e-003**	**2.5600e-003**	**0.0240**	**4.0000e-005**	**3.5100e-003**	**3.0000e-005**	**3.5300e-003**	**9.3000e-004**	**2.0000e-005**	**9.6000e-004**	**0.0000**	**2.9963**	**2.9963**	**1.9000e-004**	**0.0000**	**3.0002**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Archit. Coating	1.9200					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	3.3200e-003	0.0219	0.0187	3.0000e-005		1.7300e-003	1.7300e-003		1.7300e-003	1.7300e-003	0.0000	2.5533	2.5533	2.7000e-004	0.0000	2.5589
Total	**1.9233**	**0.0219**	**0.0187**	**3.0000e-005**		**1.7300e-003**	**1.7300e-003**		**1.7300e-003**	**1.7300e-003**	**0.0000**	**2.5533**	**2.5533**	**2.7000e-004**	**0.0000**	**2.5589**

3.7 Architectural Coating - 2017

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	1.5000e-003	2.5600e-003	0.0240	4.0000e-005	3.5100e-003	3.0000e-005	3.5300e-003	9.3000e-004	2.0000e-005	9.6000e-004	0.0000	2.9963	2.9963	1.9000e-004	0.0000	3.0002
Total	**1.5000e-003**	**2.5600e-003**	**0.0240**	**4.0000e-005**	**3.5100e-003**	**3.0000e-005**	**3.5300e-003**	**9.3000e-004**	**2.0000e-005**	**9.6000e-004**	**0.0000**	**2.9963**	**2.9963**	**1.9000e-004**	**0.0000**	**3.0002**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

Improve Pedestrian Network

Encourage Telecommuting and Alternative Work Schedules

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	0.9714	2.5750	12.4346	0.0180	1.1276	0.0394	1.1670	0.3016	0.0362	0.3379	0.0000	1,362.7859	1,362.7859	0.0543	0.0000	1,363.9267
Unmitigated	0.9910	2.7105	12.8684	0.0191	1.2054	0.0420	1.2474	0.3224	0.0386	0.3611	0.0000	1,453.0514	1,453.0514	0.0576	0.0000	1,454.2601

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
General Office Building	1,750.59	376.83	155.82	3,170,041	2,965,305
Parking Lot	0.00	0.00	0.00		
Total	1,750.59	376.83	155.82	3,170,041	2,965,305

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
General Office Building	9.50	7.30	7.30	33.00	48.00	19.00	77	19	4
Parking Lot	9.50	7.30	7.30	0.00	0.00	0.00	0	0	0

LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
0.433084	0.067774	0.178855	0.157581	0.054931	0.008753	0.007036	0.074865	0.001146	0.001007	0.009750	0.000669	0.004549

4.4 Fleet Mix

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Electricity Mitigated						0.0000	0.0000		0.0000	0.0000	0.0000	562.1611	562.1611	0.0258	5.3500e-003	564.3612
Electricity Unmitigated						0.0000	0.0000		0.0000	0.0000	0.0000	562.1611	562.1611	0.0258	5.3500e-003	564.3612
NaturalGas Mitigated	0.0155	0.1405	0.1180	8.4000e-004		0.0107	0.0107		0.0107	0.0107	0.0000	152.9818	152.9818	2.9300e-003	2.8000e-003	153.9128
NaturalGas Unmitigated	0.0155	0.1405	0.1180	8.4000e-004		0.0107	0.0107		0.0107	0.0107	0.0000	152.9818	152.9818	2.9300e-003	2.8000e-003	153.9128

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
General Office Building	2.86677e+006	0.0155	0.1405	0.1180	8.4000e-004		0.0107	0.0107		0.0107	0.0107	0.0000	152.9818	152.9818	2.9300e-003	2.8000e-003	153.9128
Parking Lot	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0155**	**0.1405**	**0.1180**	**8.4000e-004**		**0.0107**	**0.0107**		**0.0107**	**0.0107**	**0.0000**	**152.9818**	**152.9818**	**2.9300e-003**	**2.8000e-003**	**153.9128**

5.2 Energy by Land Use - NaturalGas

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
General Office Building	2.86677e+006	0.0155	0.1405	0.1180	8.4000e-004		0.0107	0.0107		0.0107	0.0107	0.0000	152.9818	152.9818	2.9300e-003	2.8000e-003	153.9128
Parking Lot	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0155**	**0.1405**	**0.1180**	**8.4000e-004**		**0.0107**	**0.0107**		**0.0107**	**0.0107**	**0.0000**	**152.9818**	**152.9818**	**2.9300e-003**	**2.8000e-003**	**153.9128**

5.3 Energy by Land Use - Electricity

Unmitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
General Office Building	1.76808e+006	505.9660	0.0233	4.8100e-003	507.9461
Parking Lot	196372	56.1952	2.5800e-003	5.3000e-004	56.4151
Total		**562.1611**	**0.0258**	**5.3400e-003**	**564.3612**

5.3 Energy by Land Use - Electricity

Mitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
Parking Lot	196372	56.1952	2.5800e-003	5.3000e-004	56.4151
General Office Building	1.76808e+006	505.9660	0.0233	4.8100e-003	507.9461
Total		**562.1611**	**0.0258**	**5.3400e-003**	**564.3612**

6.0 Area Detail

6.1 Mitigation Measures Area

Use Low VOC Paint - Non-Residential Interior

Use Low VOC Paint - Non-Residential Exterior

Use Low VOC Cleaning Supplies

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	1.5732	3.0000e-005	3.5600e-003	0.0000		1.0000e-005	1.0000e-005		1.0000e-005	1.0000e-005	0.0000	6.8300e-003	6.8300e-003	2.0000e-005	0.0000	7.2200e-003
Unmitigated	1.6848	3.0000e-005	3.5600e-003	0.0000		1.0000e-005	1.0000e-005		1.0000e-005	1.0000e-005	0.0000	6.8300e-003	6.8300e-003	2.0000e-005	0.0000	7.2200e-003

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	0.1920					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	1.4925					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	3.4000e-004	3.0000e-005	3.5600e-003	0.0000		1.0000e-005	1.0000e-005		1.0000e-005	1.0000e-005	0.0000	6.8300e-003	6.8300e-003	2.0000e-005	0.0000	7.2200e-003
Total	**1.6848**	**3.0000e-005**	**3.5600e-003**	**0.0000**		**1.0000e-005**	**1.0000e-005**		**1.0000e-005**	**1.0000e-005**	**0.0000**	**6.8300e-003**	**6.8300e-003**	**2.0000e-005**	**0.0000**	**7.2200e-003**

6.2 Area by SubCategory

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	0.1920					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	1.3809					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	3.4000e-004	3.0000e-005	3.5600e-003	0.0000		1.0000e-005	1.0000e-005		1.0000e-005	1.0000e-005	0.0000	6.8300e-003	6.8300e-003	2.0000e-005	0.0000	7.2200e-003
Total	**1.5732**	**3.0000e-005**	**3.5600e-003**	**0.0000**		**1.0000e-005**	**1.0000e-005**		**1.0000e-005**	**1.0000e-005**	**0.0000**	**6.8300e-003**	**6.8300e-003**	**2.0000e-005**	**0.0000**	**7.2200e-003**

7.0 Water Detail

7.1 Mitigation Measures Water

Install Low Flow Bathroom Faucet

Install Low Flow Kitchen Faucet

Install Low Flow Toilet

Install Low Flow Shower

Use Water Efficient Irrigation System

Use Water Efficient Landscaping

	Total CO2	CH4	N2O	CO2e
Category	MT/yr			
Mitigated	143.1209	0.7428	0.0187	164.5039
Unmitigated	169.3332	0.9282	0.0233	196.0388

7.2 Water by Land Use

Unmitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
General Office Building	28.2597 / 17.3204	169.3332	0.9282	0.0233	196.0388
Parking Lot	0 / 0	0.0000	0.0000	0.0000	0.0000
Total		**169.3332**	**0.9282**	**0.0233**	**196.0388**

7.2 Water by Land Use

Mitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
General Office Building	22.6077 / 16.2639	143.1209	0.7428	0.0187	164.5039
Parking Lot	0 / 0	0.0000	0.0000	0.0000	0.0000
Total		**143.1209**	**0.7428**	**0.0187**	**164.5039**

8.0 Waste Detail

8.1 Mitigation Measures Waste

Institute Recycling and Composting Services

Category/Year

	Total CO2	CH4	N2O	CO2e
	MT/yr			
Mitigated	0.0000	0.0000	0.0000	0.0000
Unmitigated	30.0163	1.7739	0.0000	67.2684

8.2 Waste by Land Use

Unmitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
General Office Building	147.87	30.0163	1.7739	0.0000	67.2684
Parking Lot	0	0.0000	0.0000	0.0000	0.0000
Total		**30.0163**	**1.7739**	**0.0000**	**67.2684**

Mitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
General Office Building		0.0000	0.0000	0.0000	0.0000
Parking Lot		0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Vegetation

Edwards AFB IDP1

Mojave Desert Air Basin, Summer

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
General Office Building	159.00	1000sqft	3.65	159,000.00	0
Parking Lot	223.15	1000sqft	5.12	223,150.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.6	**Precipitation Freq (Days)**	31
Climate Zone	7			**Operational Year**	2018
Utility Company	Southern California Edison				
CO2 Intensity (lb/MWhr)	630.89	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use -

Construction Phase - Total construction completed per year. Coating operations estimated to occur over a 30 period spread over posssibly multiple sites.

Off-road Equipment - Compressor operating hrs reduced and architectural coating phase extended to reduce emissions.

Energy Mitigation -

Construction Off-road Equipment Mitigation - Equipment with Tier 2 engines

Table Name	Column Name	Default Value	New Value
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstructionPhase	NumDays	20.00	30.00
tblConstructionPhase	NumDays	230.00	170.00
tblConstructionPhase	PhaseEndDate	1/12/2018	12/29/2017
tblConstructionPhase	PhaseStartDate	12/2/2017	11/20/2017
tblOffRoadEquipment	UsageHours	6.00	4.00
tblProjectCharacteristics	OperationalYear	2014	2018
tblTripsAndVMT	HaulingTripNumber	0.00	331.00

2.0 Emissions Summary

2.1 Overall Construction (Maximum Daily Emission)

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2017	131.2942	51.8486	40.5306	0.0560	18.2141	2.7553	20.9694	9.9699	2.5349	12.5048	0.0000	5,219.3301	5,219.3301	1.2351	0.0000	5,245.2677
Total	**131.2942**	**51.8486**	**40.5306**	**0.0560**	**18.2141**	**2.7553**	**20.9694**	**9.9699**	**2.5349**	**12.5048**	**0.0000**	**5,219.3301**	**5,219.3301**	**1.2351**	**0.0000**	**5,245.2677**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2017	131.2942	51.8486	40.5306	0.0560	8.2777	2.7553	11.0330	4.5080	2.5349	7.0429	0.0000	5,219.3301	5,219.3301	1.2351	0.0000	5,245.2677
Total	**131.2942**	**51.8486**	**40.5306**	**0.0560**	**8.2777**	**2.7553**	**11.0330**	**4.5080**	**2.5349**	**7.0429**	**0.0000**	**5,219.3301**	**5,219.3301**	**1.2351**	**0.0000**	**5,245.2677**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**54.55**	**0.00**	**47.39**	**54.78**	**0.00**	**43.68**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	9.2338	3.7000e-004	0.0396	0.0000		1.4000e-004	1.4000e-004		1.4000e-004	1.4000e-004		0.0836	0.0836	2.3000e-004		0.0885
Energy	0.0847	0.7700	0.6468	4.6200e-003		0.0585	0.0585		0.0585	0.0585		924.0193	924.0193	0.0177	0.0169	929.6428
Mobile	7.6697	18.3248	89.5731	0.1481	8.9020	0.3040	9.2060	2.3777	0.2798	2.6574		12,343.4364	12,343.4364	0.4602		12,353.1001
Total	**16.9882**	**19.0952**	**90.2595**	**0.1527**	**8.9020**	**0.3627**	**9.2647**	**2.3777**	**0.3384**	**2.7161**		**13,267.5394**	**13,267.5394**	**0.4781**	**0.0169**	**13,282.8313**

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	8.6224	3.7000e-004	0.0396	0.0000		1.4000e-004	1.4000e-004		1.4000e-004	1.4000e-004		0.0836	0.0836	2.3000e-004		0.0885
Energy	0.0847	0.7700	0.6468	4.6200e-003		0.0585	0.0585		0.0585	0.0585		924.0193	924.0193	0.0177	0.0169	929.6428
Mobile	7.5209	17.4181	85.8941	0.1389	8.3271	0.2854	8.6125	2.2241	0.2626	2.4867		11,575.5684	11,575.5684	0.4343		11,584.6881
Total	**16.2280**	**18.1885**	**86.5805**	**0.1435**	**8.3271**	**0.3440**	**8.6711**	**2.2241**	**0.3213**	**2.5454**		**12,499.6714**	**12,499.6714**	**0.4522**	**0.0169**	**12,514.4193**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**4.47**	**4.75**	**4.08**	**6.02**	**6.46**	**5.14**	**6.41**	**6.46**	**5.07**	**6.29**	**0.00**	**5.79**	**5.79**	**5.42**	**0.00**	**5.79**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Demolition	Demolition	1/1/2017	1/27/2017	5	20	
2	Site Preparation	Site Preparation	1/28/2017	2/10/2017	5	10	
3	Grading	Grading	2/11/2017	3/10/2017	5	20	
4	Building Construction	Building Construction	3/11/2017	11/3/2017	5	170	
5	Paving	Paving	11/4/2017	12/1/2017	5	20	
6	Architectural Coating	Architectural Coating	11/20/2017	12/29/2017	5	30	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 10

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 248,542; Non-Residential Outdoor: 82,847 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Demolition	Concrete/Industrial Saws	1	8.00	81	0.73
Demolition	Excavators	3	8.00	162	0.38
Demolition	Rubber Tired Dozers	2	8.00	255	0.40
Site Preparation	Rubber Tired Dozers	3	8.00	255	0.40
Site Preparation	Tractors/Loaders/Backhoes	4	8.00	97	0.37
Grading	Excavators	1	8.00	162	0.38
Grading	Graders	1	8.00	174	0.41
Grading	Rubber Tired Dozers	1	8.00	255	0.40
Grading	Tractors/Loaders/Backhoes	3	8.00	97	0.37
Building Construction	Cranes	1	7.00	226	0.29
Building Construction	Forklifts	3	8.00	89	0.20
Building Construction	Generator Sets	1	8.00	84	0.74
Building Construction	Tractors/Loaders/Backhoes	3	7.00	97	0.37
Building Construction	Welders	1	8.00	46	0.45
Paving	Pavers	2	8.00	125	0.42
Paving	Paving Equipment	2	8.00	130	0.36
Paving	Rollers	2	8.00	80	0.38
Architectural Coating	Air Compressors	1	4.00	78	0.48

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Demolition	6	15.00	0.00	67.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Site Preparation	7	18.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Grading	6	15.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction	9	145.00	63.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Paving	6	15.00	0.00	331.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Architectural Coating	1	29.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

Use Cleaner Engines for Construction Equipment

Water Exposed Area

Clean Paved Roads

3.2 Demolition - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					0.7375	0.0000	0.7375	0.1117	0.0000	0.1117			0.0000			0.0000
Off-Road	4.0482	42.6971	33.8934	0.0399		2.1252	2.1252		1.9797	1.9797		4,036.4674	4,036.4674	1.1073		4,059.7211
Total	**4.0482**	**42.6971**	**33.8934**	**0.0399**	**0.7375**	**2.1252**	**2.8627**	**0.1117**	**1.9797**	**2.0914**		**4,036.4674**	**4,036.4674**	**1.1073**		**4,059.7211**

3.2 Demolition - 2017

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0645	0.5772	0.8128	2.3900e-003	0.0587	0.0165	0.0752	0.0161	0.0152	0.0313		236.7617	236.7617	1.3000e-003		236.7891
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0603	0.0793	0.9447	1.5800e-003	0.1232	8.9000e-004	0.1241	0.0327	8.2000e-004	0.0335		125.0813	125.0813	7.1500e-003		125.2315
Total	**0.1248**	**0.6565**	**1.7575**	**3.9700e-003**	**0.1819**	**0.0174**	**0.1993**	**0.0488**	**0.0160**	**0.0648**		**361.8430**	**361.8430**	**8.4500e-003**		**362.0206**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					0.3319	0.0000	0.3319	0.0503	0.0000	0.0503			0.0000			0.0000
Off-Road	4.0482	42.6971	33.8934	0.0399		2.1252	2.1252		1.9797	1.9797	0.0000	4,036.4674	4,036.4674	1.1073		4,059.7211
Total	**4.0482**	**42.6971**	**33.8934**	**0.0399**	**0.3319**	**2.1252**	**2.4571**	**0.0503**	**1.9797**	**2.0300**	**0.0000**	**4,036.4674**	**4,036.4674**	**1.1073**		**4,059.7211**

3.2 Demolition - 2017

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0645	0.5772	0.8128	2.3900e-003	0.0587	0.0165	0.0752	0.0161	0.0152	0.0313		236.7617	236.7617	1.3000e-003		236.7891
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0603	0.0793	0.9447	1.5800e-003	0.1232	8.9000e-004	0.1241	0.0327	8.2000e-004	0.0335		125.0813	125.0813	7.1500e-003		125.2315
Total	**0.1248**	**0.6565**	**1.7575**	**3.9700e-003**	**0.1819**	**0.0174**	**0.1993**	**0.0488**	**0.0160**	**0.0648**		**361.8430**	**361.8430**	**8.4500e-003**		**362.0206**

3.3 Site Preparation - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					18.0663	0.0000	18.0663	9.9307	0.0000	9.9307			0.0000			0.0000
Off-Road	4.8382	51.7535	39.3970	0.0391		2.7542	2.7542		2.5339	2.5339		4,003.0859	4,003.0859	1.2265		4,028.8432
Total	**4.8382**	**51.7535**	**39.3970**	**0.0391**	**18.0663**	**2.7542**	**20.8205**	**9.9307**	**2.5339**	**12.4646**		**4,003.0859**	**4,003.0859**	**1.2265**		**4,028.8432**

3.3 Site Preparation - 2017

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0724	0.0951	1.1336	1.8900e-003	0.1479	1.0700e-003	0.1489	0.0392	9.8000e-004	0.0402		150.0975	150.0975	8.5900e-003		150.2778
Total	**0.0724**	**0.0951**	**1.1336**	**1.8900e-003**	**0.1479**	**1.0700e-003**	**0.1489**	**0.0392**	**9.8000e-004**	**0.0402**		**150.0975**	**150.0975**	**8.5900e-003**		**150.2778**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					8.1298	0.0000	8.1298	4.4688	0.0000	4.4688			0.0000			0.0000
Off-Road	4.8382	51.7535	39.3970	0.0391		2.7542	2.7542		2.5339	2.5339	0.0000	4,003.0859	4,003.0859	1.2265		4,028.8432
Total	**4.8382**	**51.7535**	**39.3970**	**0.0391**	**8.1298**	**2.7542**	**10.8840**	**4.4688**	**2.5339**	**7.0027**	**0.0000**	**4,003.0859**	**4,003.0859**	**1.2265**		**4,028.8432**

3.3 Site Preparation - 2017

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0724	0.0951	1.1336	1.8900e-003	0.1479	1.0700e-003	0.1489	0.0392	9.8000e-004	0.0402		150.0975	150.0975	8.5900e-003		150.2778
Total	**0.0724**	**0.0951**	**1.1336**	**1.8900e-003**	**0.1479**	**1.0700e-003**	**0.1489**	**0.0392**	**9.8000e-004**	**0.0402**		**150.0975**	**150.0975**	**8.5900e-003**		**150.2778**

3.4 Grading - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					6.5523	0.0000	6.5523	3.3675	0.0000	3.3675			0.0000			0.0000
Off-Road	3.4555	35.9825	25.3812	0.0297		2.0388	2.0388		1.8757	1.8757		3,043.666 7	3,043.666 7	0.9326		3,063.250 7
Total	**3.4555**	**35.9825**	**25.3812**	**0.0297**	**6.5523**	**2.0388**	**8.5912**	**3.3675**	**1.8757**	**5.2432**		**3,043.666 7**	**3,043.666 7**	**0.9326**		**3,063.250 7**

3.4 Grading - 2017

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0603	0.0793	0.9447	1.5800e-003	0.1232	8.9000e-004	0.1241	0.0327	8.2000e-004	0.0335		125.0813	125.0813	7.1500e-003		125.2315
Total	**0.0603**	**0.0793**	**0.9447**	**1.5800e-003**	**0.1232**	**8.9000e-004**	**0.1241**	**0.0327**	**8.2000e-004**	**0.0335**		**125.0813**	**125.0813**	**7.1500e-003**		**125.2315**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					2.9486	0.0000	2.9486	1.5154	0.0000	1.5154			0.0000			0.0000
Off-Road	3.4555	35.9825	25.3812	0.0297		2.0388	2.0388		1.8757	1.8757	0.0000	3,043.666 7	3,043.666 7	0.9326		3,063.250 7
Total	**3.4555**	**35.9825**	**25.3812**	**0.0297**	**2.9486**	**2.0388**	**4.9874**	**1.5154**	**1.8757**	**3.3911**	**0.0000**	**3,043.666 7**	**3,043.666 7**	**0.9326**		**3,063.250 7**

3.4 Grading - 2017

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0603	0.0793	0.9447	1.5800e-003	0.1232	8.9000e-004	0.1241	0.0327	8.2000e-004	0.0335		125.0813	125.0813	7.1500e-003		125.2315
Total	**0.0603**	**0.0793**	**0.9447**	**1.5800e-003**	**0.1232**	**8.9000e-004**	**0.1241**	**0.0327**	**8.2000e-004**	**0.0335**		**125.0813**	**125.0813**	**7.1500e-003**		**125.2315**

3.5 Building Construction - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	3.1024	26.4057	18.1291	0.0268		1.7812	1.7812		1.6730	1.6730		2,639.8053	2,639.8053	0.6497		2,653.4490
Total	**3.1024**	**26.4057**	**18.1291**	**0.0268**		**1.7812**	**1.7812**		**1.6730**	**1.6730**		**2,639.8053**	**2,639.8053**	**0.6497**		**2,653.4490**

3.5 Building Construction - 2017

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.6836	4.4251	8.5339	0.0139	0.4129	0.1028	0.5157	0.1170	0.0945	0.2115		1,370.405 9	1,370.405 9	8.2600e-003		1,370.579 4
Worker	0.5828	0.7663	9.1316	0.0153	1.1911	8.6300e-003	1.1998	0.3160	7.9300e-003	0.3239		1,209.118 9	1,209.118 9	0.0692		1,210.571 2
Total	**1.2664**	**5.1915**	**17.6655**	**0.0292**	**1.6040**	**0.1114**	**1.7154**	**0.4329**	**0.1025**	**0.5354**		**2,579.524 8**	**2,579.524 8**	**0.0774**		**2,581.150 6**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	3.1024	26.4057	18.1291	0.0268		1.7812	1.7812		1.6730	1.6730	0.0000	2,639.805 3	2,639.805 3	0.6497		2,653.449 0
Total	**3.1024**	**26.4057**	**18.1291**	**0.0268**		**1.7812**	**1.7812**		**1.6730**	**1.6730**	**0.0000**	**2,639.805 3**	**2,639.805 3**	**0.6497**		**2,653.449 0**

3.5 Building Construction - 2017

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.6836	4.4251	8.5339	0.0139	0.4129	0.1028	0.5157	0.1170	0.0945	0.2115		1,370.4059	1,370.4059	8.2600e-003		1,370.5794
Worker	0.5828	0.7663	9.1316	0.0153	1.1911	8.6300e-003	1.1998	0.3160	7.9300e-003	0.3239		1,209.1189	1,209.1189	0.0692		1,210.5712
Total	**1.2664**	**5.1915**	**17.6655**	**0.0292**	**1.6040**	**0.1114**	**1.7154**	**0.4329**	**0.1025**	**0.5354**		**2,579.5248**	**2,579.5248**	**0.0774**		**2,581.1506**

3.6 Paving - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	1.9074	20.2964	14.7270	0.0223		1.1384	1.1384		1.0473	1.0473		2,281.0588	2,281.0588	0.6989		2,295.7360
Paving	0.6707					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Total	**2.5781**	**20.2964**	**14.7270**	**0.0223**		**1.1384**	**1.1384**		**1.0473**	**1.0473**		**2,281.0588**	**2,281.0588**	**0.6989**		**2,295.7360**

3.6 Paving - 2017

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.3187	2.8517	4.0156	0.0118	0.2901	0.0815	0.3715	0.0796	0.0749	0.1545		1,169.6736	1,169.6736	6.4300e-003		1,169.8086
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0603	0.0793	0.9447	1.5800e-003	0.1232	8.9000e-004	0.1241	0.0327	8.2000e-004	0.0335		125.0813	125.0813	7.1500e-003		125.2315
Total	**0.3790**	**2.9310**	**4.9603**	**0.0134**	**0.4133**	**0.0823**	**0.4957**	**0.1123**	**0.0757**	**0.1880**		**1,294.7548**	**1,294.7548**	**0.0136**		**1,295.0401**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	1.9074	20.2964	14.7270	0.0223		1.1384	1.1384		1.0473	1.0473	0.0000	2,281.0588	2,281.0588	0.6989		2,295.7360
Paving	0.6707					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Total	**2.5781**	**20.2964**	**14.7270**	**0.0223**		**1.1384**	**1.1384**		**1.0473**	**1.0473**	**0.0000**	**2,281.0588**	**2,281.0588**	**0.6989**		**2,295.7360**

3.6 Paving - 2017

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.3187	2.8517	4.0156	0.0118	0.2901	0.0815	0.3715	0.0796	0.0749	0.1545		1,169.6736	1,169.6736	6.4300e-003		1,169.8086
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0603	0.0793	0.9447	1.5800e-003	0.1232	8.9000e-004	0.1241	0.0327	8.2000e-004	0.0335		125.0813	125.0813	7.1500e-003		125.2315
Total	**0.3790**	**2.9310**	**4.9603**	**0.0134**	**0.4133**	**0.0823**	**0.4957**	**0.1123**	**0.0757**	**0.1880**		**1,294.7548**	**1,294.7548**	**0.0136**		**1,295.0401**

3.7 Architectural Coating - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Archit. Coating	127.9990					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Off-Road	0.2215	1.4567	1.2454	1.9800e-003		0.1156	0.1156		0.1156	0.1156		187.6320	187.6320	0.0198		188.0480
Total	**128.2205**	**1.4567**	**1.2454**	**1.9800e-003**		**0.1156**	**0.1156**		**0.1156**	**0.1156**		**187.6320**	**187.6320**	**0.0198**		**188.0480**

3.7 Architectural Coating - 2017

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.1166	0.1533	1.8263	3.0500e-003	0.2382	1.7300e-003	0.2400	0.0632	1.5900e-003	0.0648		241.8238	241.8238	0.0138		242.1143
Total	**0.1166**	**0.1533**	**1.8263**	**3.0500e-003**	**0.2382**	**1.7300e-003**	**0.2400**	**0.0632**	**1.5900e-003**	**0.0648**		**241.8238**	**241.8238**	**0.0138**		**242.1143**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Archit. Coating	127.9990					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Off-Road	0.2215	1.4567	1.2454	1.9800e-003		0.1156	0.1156		0.1156	0.1156	0.0000	187.6320	187.6320	0.0198		188.0480
Total	**128.2205**	**1.4567**	**1.2454**	**1.9800e-003**		**0.1156**	**0.1156**		**0.1156**	**0.1156**	**0.0000**	**187.6320**	**187.6320**	**0.0198**		**188.0480**

3.7 Architectural Coating - 2017

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.1166	0.1533	1.8263	3.0500e-003	0.2382	1.7300e-003	0.2400	0.0632	1.5900e-003	0.0648		241.8238	241.8238	0.0138		242.1143
Total	**0.1166**	**0.1533**	**1.8263**	**3.0500e-003**	**0.2382**	**1.7300e-003**	**0.2400**	**0.0632**	**1.5900e-003**	**0.0648**		**241.8238**	**241.8238**	**0.0138**		**242.1143**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

Improve Pedestrian Network

Encourage Telecommuting and Alternative Work Schedules

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	7.5209	17.4181	85.8941	0.1389	8.3271	0.2854	8.6125	2.2241	0.2626	2.4867		11,575.5684	11,575.5684	0.4343		11,584.6881
Unmitigated	7.6697	18.3248	89.5731	0.1481	8.9020	0.3040	9.2060	2.3777	0.2798	2.6574		12,343.4364	12,343.4364	0.4602		12,353.1001

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
General Office Building	1,750.59	376.83	155.82	3,170,041	2,965,305
Parking Lot	0.00	0.00	0.00		
Total	1,750.59	376.83	155.82	3,170,041	2,965,305

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
General Office Building	9.50	7.30	7.30	33.00	48.00	19.00	77	19	4
Parking Lot	9.50	7.30	7.30	0.00	0.00	0.00	0	0	0

4.4 Fleet Mix

LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
0.433084	0.067774	0.178855	0.157581	0.054931	0.008753	0.007036	0.074865	0.001146	0.001007	0.009750	0.000669	0.004549

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

Category	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
	lb/day										lb/day					
NaturalGas Mitigated	0.0847	0.7700	0.6468	4.6200e-003		0.0585	0.0585		0.0585	0.0585		924.0193	924.0193	0.0177	0.0169	929.6428
NaturalGas Unmitigated	0.0847	0.7700	0.6468	4.6200e-003		0.0585	0.0585		0.0585	0.0585		924.0193	924.0193	0.0177	0.0169	929.6428

5.2 Energy by Land Use - NaturalGas

Unmitigated

Land Use	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
	kBTU/yr	lb/day										lb/day					
General Office Building	7854.16	0.0847	0.7700	0.6468	4.6200e-003		0.0585	0.0585		0.0585	0.0585		924.0193	924.0193	0.0177	0.0169	929.6428
Parking Lot	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0847**	**0.7700**	**0.6468**	**4.6200e-003**		**0.0585**	**0.0585**		**0.0585**	**0.0585**		**924.0193**	**924.0193**	**0.0177**	**0.0169**	**929.6428**

5.2 Energy by Land Use - NaturalGas

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
General Office Building	7.85416	0.0847	0.7700	0.6468	4.6200e-003		0.0585	0.0585		0.0585	0.0585		924.0193	924.0193	0.0177	0.0169	929.6428
Parking Lot	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0847**	**0.7700**	**0.6468**	**4.6200e-003**		**0.0585**	**0.0585**		**0.0585**	**0.0585**		**924.0193**	**924.0193**	**0.0177**	**0.0169**	**929.6428**

6.0 Area Detail

6.1 Mitigation Measures Area

Use Low VOC Paint - Non-Residential Interior

Use Low VOC Paint - Non-Residential Exterior

Use Low VOC Cleaning Supplies

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	8.6224	3.7000e-004	0.0396	0.0000		1.4000e-004	1.4000e-004		1.4000e-004	1.4000e-004		0.0836	0.0836	2.3000e-004		0.0885
Unmitigated	9.2338	3.7000e-004	0.0396	0.0000		1.4000e-004	1.4000e-004		1.4000e-004	1.4000e-004		0.0836	0.0836	2.3000e-004		0.0885

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	1.0521					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	8.1780					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Landscaping	3.7800e-003	3.7000e-004	0.0396	0.0000		1.4000e-004	1.4000e-004		1.4000e-004	1.4000e-004		0.0836	0.0836	2.3000e-004		0.0885
Total	**9.2338**	**3.7000e-004**	**0.0396**	**0.0000**		**1.4000e-004**	**1.4000e-004**		**1.4000e-004**	**1.4000e-004**		**0.0836**	**0.0836**	**2.3000e-004**		**0.0885**

6.2 Area by SubCategory

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	1.0521					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	7.5666					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Landscaping	3.7800e-003	3.7000e-004	0.0396	0.0000		1.4000e-004	1.4000e-004		1.4000e-004	1.4000e-004		0.0836	0.0836	2.3000e-004		0.0885
Total	**8.6224**	**3.7000e-004**	**0.0396**	**0.0000**		**1.4000e-004**	**1.4000e-004**		**1.4000e-004**	**1.4000e-004**		**0.0836**	**0.0836**	**2.3000e-004**		**0.0885**

7.0 Water Detail

7.1 Mitigation Measures Water

Install Low Flow Bathroom Faucet

Install Low Flow Kitchen Faucet

Install Low Flow Toilet

Install Low Flow Shower

Use Water Efficient Irrigation System

Use Water Efficient Landscaping

8.0 Waste Detail

8.1 Mitigation Measures Waste

Institute Recycling and Composting Services

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Vegetation

APPENDIX D

INTEGRATED CULTURAL RESOURCES MANAGEMENT PLAN

DOCUMENT IS NOT ATTACHED TO THE EA -- AVAILABLE FOR OFFICIAL USE ONLY (FOUO)

APPENDIX E

INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN

DOCUMENT IS NOT ATTACHED TO THE EA BECAUSE IT IS AVAILABLE FOR OFFICIAL USE ONLY (FOUO)

APPENDIX F
BASEWIDE BIOLOGICAL OPINION

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ventura Fish and Wildlife Office
2493 Portola Road, Suite B
Ventura, California 93003

IN REPLY REFER TO:
08EVEN00-2014-F-0123

March 11, 2014

412 CE/CL
James E. Judkins
Base Civil Engineer
225 North Rosamond Boulevard
Edwards Air Force Base, California 93524

Subject: Biological Opinion for Operations and Activities at Edwards Air Force Base, California (8-8-14-F-14)

Dear Mr. Judkins:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion regarding the effects on the federally threatened desert tortoise (*Gopherus agassizii*) and its critical habitat, in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.), of all identified existing and future similar actions that are likely to occur on Edwards Air Force Base. This document also describes the criteria by which the U.S. Air Force will determine whether its actions are likely to adversely affect the desert tortoise or its critical habitat and our concurrence with actions that are undertaken within the framework of these criteria. We received your request for formal consultation on February 22, 2008.

This biological opinion is based on information which accompanied your request for consultation, conversations and correspondence with Edwards Air Force Base staff, and information contained in our files. A complete record of this consultation can be made available at the Ventura Fish and Wildlife Office.

Consultation History

Since 1990, the Air Force and Service have consulted formally on the effects of Air Force actions on the desert tortoise and its critical habitat 49 times; we have consulted informally on other actions. To date, we have completed consultations on a wide range of activities and uses, including recreational activities, construction and maintenance of infrastructure, remediation of contaminated sites, black box projects, and disposal of unstable rocket fuel. Prior to the initiation of formal consultation, staff from the Air Force and Service discussed the basic concepts of this base-wide consultation informally on several occasions.

On January 30, 2014, the Service (2014) provided the Air Force with a draft biological opinion. The Air Force (2014b) provided comments on the draft biological opinion on March 4, 2014; we have incorporated the Air Force's comments into this biological opinion, as appropriate.

ADMINISTRATION OF THE CONSULTATION

Future actions that may affect the desert tortoise or its critical habitat at Edwards Air Force Base will be evaluated in the following manner. The Environmental Management Office at Edwards Air Force Base will review all discretionary actions that the Air Force proposes on Edwards Air Force Base. Based on the nature of the activity, its potential to adversely affect desert tortoises or their critical habitat, and any measures that can be implemented to avoid or minimize the effect, the Air Force will determine whether the action will not affect, is not likely to adversely affect, or is likely to adversely affect the desert tortoise or its critical habitat.

The Air Force will maintain a record of all its activities that undergo this evaluation. For actions that do not affect or are not likely to adversely affect the desert tortoise or its critical habitat, the Air Force will include in its record:

1. The title of the action;
2. A description of the proposed action;
3. Location;
4. Size; and
5. The rationale that it used to reach its determination regarding effects to the desert tortoise or its critical habitat.

For actions that are likely to adversely affect the desert tortoise or its critical habitat, the Air Force will include in its record:

1. The title of the action;
2. A description of the proposed action;
3. Location;
4. Size;
5. The number of desert tortoises that are killed, injured, and moved from harm's way;
6. The amount of habitat disturbed or lost, with a notation as to whether the affected area was designated critical habitat;
7. A listed of authorized biologists who worked on actions covered by this consultation in the reporting year; and
8. A brief but comprehensive discussion of whether the protective measures were effective. If the measures were not effective, the Air Force will explain why the measures did not function as expected and recommendations for implementing more effective measures.

In past consultations with the Air Force, the Service has authorized biologists to implement protective measures and handle desert tortoises on a project-by-project basis. Upon completion of this consultation, the Air Force will not request such authorization on a project-by-project basis. From this point, any person that is approved by the Service to undertake the duties of an authorized biologist for actions proposed by the Air Force that are covered by this biological

opinion may also perform those duties on future actions. If the Air Force determines that an authorized biologist is not performing his or her duties in a satisfactory manner, the Air Force will notify the Service at the earliest possible time it makes this determination.

The Service and Air Force agree that some actions may be proposed in the future that may result in effects beyond the scope of those considered in this biological opinion. In the case of such actions, the Air Force and Service will discuss whether this biological opinion sufficiently considered effects to the desert tortoise and its critical habitat in light of the proposed action and whether re-initiation of formal consultation or initiation of a separate consultation is appropriate.

If staff from the Service and Air Force cannot agree on a course of action after discussions on this or other issues, any disagreement will be elevated to the Ventura Fish and Wildlife Office's Assistant Field Supervisor and the Air Force Civil Engineer Director and/or Environmental Management Division Chief for resolution. If further elevation is required, the Field Supervisor of the Ventura Fish and Wildlife Office and the Installation Commander of Edwards Air Force Base will be contacted to resolve the issue. Although the elevation of issues is likely to be an infrequent occurrence, the Air Force and Service consider this procedure to be a useful tool to maintain efficient processes and a healthy working relationship between our agencies.

The Air Force will provide the Service with an annual report of the activities that it conducts under the auspices of this consultation. The annual report will include the information that the Air Force will maintain in its records for any activity it determined was likely to adversely affect the desert tortoise or its critical habitat, as described in this section. The annual report will be provided to the Service by January 31 of each year this biological opinion is in effect.

The annual report will also contain information on conservation activities that the Air Force undertook in the previous year. Such activities may include, but are not limited to, acquisition of land through the Readiness and Environmental Preparedness Initiative, results of research on desert tortoises conducted or funded by the Air Force, and the results of relevant research conducted under the Air Force's Small Business Initiative.

The Ventura Fish and Wildlife Office's Assistant Field Supervisor, the Air Force Civil Engineer Director and/or Environmental Management Division Chief, and appropriate staff will meet annually to review how this consultation is functioning and to discuss any potentially important events in the upcoming year. This meeting could be held in conjunction with the quarterly meeting of the Desert Managers Group that occurs nearest the time the annual report is due. If the Service and Air Force agree that such a meeting is unnecessary in any given year, the meeting may be cancelled.

Criteria for Use in Reaching Appropriate Determinations

The Air Force will use the following outline to determine the appropriate level of consultation required for each proposed action.

1) Projects in which any effects would occur outside of desert tortoise habitat would have no effect on the species; the Air Force will document its determinations in these situations for its own records but would not need to contact the Ventura Fish and Wildlife Office. If the Air Force requires technical assistance from the Service to determine if suitable habitat for desert tortoises would be affected, it should contact us by phone or electronic mail.

2) If the following criteria are met, a determination of not likely to adversely affect the desert tortoise would be appropriate:

   a) The project is within habitat of the desert tortoise;

   b) Desert tortoise habitat is present, but degraded or disturbed, in the project area. For the purposes of this consultation, the Air Force and Service consider degraded habitat to be that habitat which has been affected by previous activities. Degraded habitat will generally exhibit a lower diversity and density of native shrubs and disrupted substrates than undisturbed habitat. The Air Force and Service may consider certain washes to be disturbed habitat; the fundamental guidance in such areas is that the evidence of the maintenance activity would no longer be visible after an event where water flows in the wash. The loss or disturbance of a minor amount of undisturbed habitat may also be considered as being not likely to adversely affect the species, when considered with regard to its distribution in the action area; and

   c) Neither desert tortoises nor their diagnostic sign are observed during surveys or a habitat assessment.

   In cases where a determination is not entirely clear from a verbal description, the Air Force will provide the Service with a photograph (aerial or otherwise, as appropriate) of the project site to assist in its determination.

3) If the following criteria are met, a determination of not likely to adversely affect critical habitat for the desert tortoise would be appropriate:

   a) The project is within designated critical habitat, but the primary constituent elements of desert tortoise critical habitat are not present;

   b) The primary constituent elements would not be affected by the proposed project; or

   c) Effects to the primary constituent elements would be so minor that they are not substantially measurable when considered within the context of the critical habitat unit. Such effects may occur, for example, when a narrow strip of land supporting the primary constituent elements of critical habitat at the edge of an existing road may be affected by an action.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The Air Force requested consultation on a variety of mission support actions, including recurring and predicted new projects and future unknown projects. For this biological opinion, we worked with the Air Force to assess the threats to desert tortoises and their critical habitat associated with each type of proposed activity. Future actions under the control of the Air Force are expected to cause impacts that are similar to those discussed in the biological evaluation. The following table lists the Air Force's activities and notes the general manner by which the activity would affect the desert tortoise and its critical habitat (e.g., ground disturbance, use of roads, etc.). We will then consider more specifically the nature of these effects on the desert tortoise and its critical habitat and the measures that the Air Force has proposed to avoid, reduce, or minimize these effects. The biological evaluation contains a more detailed description of its proposed activities (Air Force 2008a).

Table 1 - Threats and Associated Activities of Proposed Actioin

		Driving off-road	Driving on road	Ground Disturbance	Explosions (potential for fire)	Non-native Plants	Common Ravens	Moving desert tortoise from harm	Personnel on Foot	Habitat Conversion
Range Flight Operations	Desert tortoise	N	Y	Y	Y	N	N	N	N	N
	Critical Habitat	N	Y	Y	Y	N	N	N	N	N
Airfield Flight Operations	Desert tortoise	N	N	N	N	N	N	N	N	N
	Critical Habitat	N/A								
Range Ground Operations	Desert tortoise	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Critical Habitat	Y	Y	Y	Y	Y	Y	Y	Y	Y
Directed Energy Operations	Desert tortoise	N	Y	N	Y	N	N	N	Y	N
	Critical Habitat	N	Y	N	Y	N	N	N	Y	N
Ordnance Expenditures	Desert tortoise	Y	Y	Y	y	N	N	Y	Y	N
	Critical Habitat	Y	Y	Y	Y	N	N	Y	Y	N
Energetic Material Expenditures	Desert tortoise	N	Y	N	y	N	N	Y	Y	N
	Critical Habitat	N	Y	N	Y	N	N	Y	Y	N
Native American Uses	Desert tortoise	N	Y	N	N	N	N	N	N	N
	Critical Habitat	N	Y	N	N	N	N	N	N	N
Research and Education	Desert tortoise	N	Y	N	N	N	N	Y	Y	N
	Critical Habitat	N	Y	N	N	N	N	Y	Y	N
Recreation	Desert tortoise	Y	Y	N	N	N	N	Y	Y	N
	Critical Habitat	N/A								
Feral Grazing Management	Desert tortoise	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Critical Habitat	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Monitoring	Desert tortoise	Y	N	Y	N	N	Y	Y	Y	Y
	Critical Habitat	Y	N	Y	N	N	Y	Y	Y	Y
Inventories/Surveys	Desert tortoise	Y	N	Y	N	Y	Y	N	Y	N
	Critical Habitat	Y	N	Y	N	Y	Y	N	Y	N
Utility Maintenance	Desert tortoise	Y	Y	Y	Y	N	N	Y	Y	N
	Critical Habitat	Y	Y	Y	Y	N	N	Y	Y	Y
Fire Management	Desert tortoise	Y	Y	Y	N	N	N	Y	Y	N
	Critical Habitat	Y	Y	Y	N	N	N	Y	Y	Y
Future Development	Desert tortoise	Y	Y	Y	N	Y	Y	Y	Y	Y
	Critical Habitat	Y	Y	Y	Y	Y	Y	Y	Y	Y

Y = Associated activity may affect the desert tortoise or its critical habitat in this manner. (Activities would affect critical habitat and habitat not designated as critical in the same basic manner; however, we do not consider effects to non-critical habitat in assessing whether a proposed action is likely to destroy or adversely modify critical habitat.)

N = Associated activity does not affect the desert tortoise or its critical habitat.

N/A = Associated activity does not occur in area of concern (desert tortoise habitat or critical habitat).

The Air Force anticipates that it may need 20,000 acres for future development of solar facilities, infrastructure, and mission activities and operations. The Air Force estimates that up to 5,000 acres of new disturbance may occur within critical habitat and 15,000 acres may occur outside of critical habitat. The Air Force would manage desert tortoises during the course of future development by following its integrated natural resources management plan.

The construction and operation of the Oro Verde Solar Project would occur within the boundaries of Edwards Air Force Base; this solar plant would require an interconnecting power line (gen-tie line) to the Windhub Substation, which lies to the northwest of base. For this reason, the Air Force requested that the Service also consider the effects of the construction and operation of the gen-tie line on the desert tortoise in this biological opinion. (The gen-tie line would not affect critical habitat; the nearest critical habitat for the desert tortoise is approximately 20 miles to the east of the easternmost portion of the gen-tie line.) The method used to construct the gen-tie line would occur in a manner similar to how the Air Force (or service companies operating within the base) would maintain utilities, although the impacts of construction would be more intense than would occur during maintenance.

To ensure that its activities do not result in numerous injuries to or mortalities of desert tortoises, the Air Force has proposed a set of thresholds that, if reached, will prompt additional action on its part to protect desert tortoises (Reinke 2009, Mull 2013a). If a desert tortoise is injured or killed in a calendar year, the Air Force will retrain those individuals that were responsible for implementing the activity, determine how to avoid future injuries or mortalities, and implement appropriate measures to reduce the number of future injuries or mortalities. The Air Force will also determine the root cause of the activities that resulted in the injury or mortality, determine appropriate measures to reduce, to the maximum extent possible, future injury or mortality, and obtain the Service's concurrence on implementation of the measures. Finally, the Air Force has proposed to re-initiate formal consultation if five desert tortoises are killed or injured in a calendar year.

The Air Force has also proposed to re-initiate formal consultation if the amount of desert tortoise habitat disturbed by its activities reaches 15,000 acres in the portion of Edwards Air Force Base that is outside of the boundaries of critical habitat. For the portion of the base within the boundaries of critical habitat, the Air Force has proposed to re-initiate formal consultation if the amount of desert tortoise habitat disturbed by its activities reaches 5,000 acres. The Air Force has been restoring lands disturbed by its activities so that these areas can support their ecological functions; the Air Force has also proposed to evaluate the effectiveness of its restoration activities and to subtract the acreage of restored habitat from the acreage of disturbed habitat as it monitors the activities it conducts under the auspices of this consultation. For example, if, in any given year, the Air Force disturbs 10 acres during its activities and restores 3 acres, the cumulative loss of habitat for the year would be 7 acres. For the purposes of tracking whether re-initiation is required, the Air Force will track the amount of habitat disturbed and restored upon completion of this biological opinion. Previously disturbed areas are not considered to be desert tortoise habitat for the purpose of tracking habitat loss; for example, any disturbance within the bed of an unpaved road would not be considered disturbance of desert tortoise habitat

because the biological and physical attributes of habitat are generally absent from such disturbed areas.

Adaptive Management Strategy

The Air Force has proposed three primary goals for its adaptive management strategy: 1) ensure that mission-related activities are conducted in compliance with Federal and State natural resource and other environmental legislation; 2) assess and monitor populations of listed, proposed, and sensitive species and general habitat conditions over time; and 3) ensure the long-term viability of desert tortoise populations within the Fremont-Kramer Desert Wildlife Management Area, while fully supporting the military mission at Edwards Air Force Base (Air Force 2008a). These goals apply to the annual and 5-year revisions of Edwards Air Force Base's integrated natural resources management plans.

Protective Measures

The Air Force has implemented a set of standardized minimization measures derived from numerous biological opinions to protect desert tortoises and conserve their habitat. These measures are applied selectively through the National Environmental Policy Act process via the Air Force Environmental Impact Analysis Process for each ground-disturbing action. The Air Force will continue implementing these minimization measures in the future as new types of projects occur in new areas that are expected to have similar impacts from mission activities.

a. Desert tortoises will be handled in full accordance with all applicable provisions and regulations of the Endangered Species Act. The phrases "authorized biologist" and "desert tortoise monitor", as used in this section are taken from the most up-to-date Service guidance (Service 2010a) and defined as follows:

    1. Authorized biologists must have thorough and current knowledge of desert tortoise behavior, natural history, ecology, and physiology, and demonstrate substantial field experience and training to safely and successfully conduct their required duties. Authorized biologists are approved to monitor project activities within desert tortoise habitat and are responsible for locating desert tortoises and their sign (i.e., conduct clearance surveys). Authorized biologists must ensure proper implementation of protective measures, and make certain that the effects of the project on the desert tortoise and its habitat are minimized in accordance with a biological opinion or incidental take permit. All incidents of noncompliance in accordance with the biological opinion or permit must be recorded and reported.

    2. Desert tortoise monitors will be approved by the authorized biologist to monitor project activities within desert tortoise habitat, ensure proper implementation of protective measures, and record and report desert tortoise and sign observations in accordance with approved protocol. They will report incidents of noncompliance in accordance with a biological opinion or permit, move desert tortoises from harm's way when desert tortoises enter project sites and place these animals in "safe areas"

pre-selected by authorized biologists or maintain the desert tortoises in their immediate possession until an authorized biologist assumes care of the animal. Desert tortoise monitors assist authorized biologists during surveys and serve as "apprentices" to acquire experience. Monitors should not conduct clearance surveys or other specialized duties of the authorized biologist unless directly supervised by an authorized biologist; "directly supervised" means the authorized biologist has direct voice and sight contact with the monitor. The desert tortoise monitor may directly supervise other personnel to assist with surveying for desert tortoises when deemed necessary.

3. None of the proposed measures will prohibit any individual from handling a desert tortoise when necessary to protect the safety or health of the animal.

b. Authorized biologists are the only individuals approved to handle desert tortoises on base. The Service's standardized form will be used for individuals to work on specific projects to verify the capabilities and experience of the potential desert tortoise biologist.

c. All base personnel (including contractors, civilian, and military employees) will be provided, at a minimum, a description of the desert tortoise, its status, and measures to minimize impacts. The material may also include the use of a multimedia presentation (videotape and printed material).

d. To the maximum extent practicable, activities will be sited to avoid effects to desert tortoises and their habitat.

e. Personnel will immediately report sightings of desert tortoises or sign found in the project area to the authorized biologist, desert tortoise monitor, or the Environmental Management Office.

f. Pre-activity surveys will be conducted, where deemed necessary, in project areas prior to ground-disturbing activities.

g. The project work areas will be fenced, flagged, or marked to define the limit of project activities.

h. Vehicles will generally remain on previously established roads and within staging areas and follow flagged off road routes that have been surveyed or cleared of desert tortoises. When driving off road, operators will minimize disturbance to vegetation and not exceed 10 miles per hour. All personnel will inspect under vehicles for desert tortoises prior to operating them in desert tortoise habitat.

i. Open excavations will be checked three times a day and authorized personnel will remove any trapped animals. Open excavations will be covered, backfilled, or fenced at the end of each workday. At the ends of a ditch or trench, a 3:1 slope will be created to allow wildlife to exit should they become trapped in the ditch or trench. All open excavations that are left unattended will be fenced, unless other methods of excluding desert tortoises are employed.

j. Any pipes left or stored on the ground in the project area will be capped on the ends to prevent entry by desert tortoises or other wildlife.

k. Parking and staging areas will be restricted to previously disturbed areas as much as possible.

l. Acres of disturbance will be tracked to provide a basis for possible future re-vegetation and restoration efforts.

m. All trash and food items will be disposed of in common raven-proof containers, and regularly removed from project sites to reduce attraction of common ravens.

n. Project activities between dusk and dawn will be confined to areas free of vegetation and cleared of desert tortoises by authorized personnel.

o. An annual report will be submitted to the Service summarizing any injury, mortality, or handling of desert tortoises, disturbance of critical habitat, and habitat restoration.

Other Measures Implemented for Specific Activities

The following minimization measures are being implemented to aid overall management of the desert tortoise on base.

Motorized Recreation Areas

a. Signs will be maintained along the designated off-road vehicle area boundaries.

b. Bulletin boards displaying up-to-date rules and safety information will be placed at the main access areas at each off-road vehicle area.

c. Law Enforcement personnel will patrol the areas to ensure that riders remain within the boundaries and use existing trails.

d. All operators of motor vehicles will take desert tortoise awareness training and carry proof of training when riding.

e. Environmental Management will monitor and record habitat disturbance. Solutions to problems that may develop will be suggested by the off-road vehicle area subcommittee and implemented by the Air Force.

Non-motorized Recreation Areas

a. Signs, notices, and other media will be used to inform personnel that use of off-road vehicle area 3 requires desert tortoise awareness training.

b. Desert tortoises crossing trails will not be moved; bikers and joggers will wait until the desert tortoise moves off the trail.

c. Activities will occur on established trails.

d. Pets not on leashes will not be allowed in the non-motorized recreation area.

Road Construction and Maintenance

a. All drainage recontouring will be limited to the greatest extent possible to reduce habitat fragmentation, where practicable.

b. Maintenance of drainage ditches will not be altered to change the direction of stormwater runoff from existing conditions to avoid potential flooding of desert tortoise burrows downslope of maintenance activities to the greatest extent possible.

c. Herbicide applicators will be instructed to watch for desert tortoises on road shoulders and to take precautions, as necessary, to ensure that no desert tortoises are sprayed.

d. Fugitive dust generated during construction will be controlled with water; the amount of water used will be restricted to the minimum amount required to maintain air quality standards.

e. Water tanks and trucks will be maintained in good working order and free of leaks so common ravens will not be attracted to standing water.

f. Installation of fencing along roadways will be implemented in areas deemed hazardous to desert tortoises to prevent injury or mortality.

Utilities

a. Aboveground gas lines will be placed at least 18 inches aboveground when they traverse desert tortoise habitat.

b. If, at any time after installation, the height of the gas pipes above the ground has been reduced to less than 18 inches, the pipelines will either be raised or the materials causing the reduction will be removed.

c. Lands above underground utilities will be re-vegetated unless a road needs to be constructed and maintained for access and maintenance activities.

d. Roads needed for utility maintenance will be concentrated in previously established corridors when possible.

e. Underground utilities will be located adjacent to or within previously disturbed areas when possible.

Re-vegetation

a. Habitat restoration required under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended under the Superfund Amendments and Reauthorization Act of 1986 for mission related ground disturbance would include using techniques to control soil erosion that have been proven successful in the desert environment and will also include use of native plants and seeds in an attempt to mimic natural biodiversity.

b. Priority for re-vegetation will be given to desert tortoise critical habitat.

c. Restoration activities will be conducted in accordance with the re-vegetation plans prepared by Edwards Air Force Base (Air Force 1994; Air Force 2012) and any new scientifically proven methodology.

d. Monitoring success of efforts will be implemented for a longer period than the standard 5-year monitoring period due to slow recovery rates of re-vegetated areas in the desert.

Management of Common Ravens

The Air Force will implement protective measures to reduce the adverse effects associated with predation of desert tortoises by common ravens. In general, the Air Force proposes to manage common ravens by controlling the use of landfills and sewage ponds, designing facilities to discourage common raven use, minimizing or eliminating food and water subsidies, providing training to on-site personnel, monitoring the presence of common ravens and their use of subsidies, and studying common raven predation on juvenile tortoises. The biological evaluation (Air Force 2008a) and integrated natural resource management plan (Air Force 2008b) contain more detailed information on these management actions.

Relocation of Desert Tortoises

In the event that future development or activities would result in the clearing of a large area of suitable desert tortoise habitat, the Air Force would relocate desert tortoises from these sites to other habitat. The Air Force will monitor all translocated desert tortoises to determine the success of the relocation.

Monitoring of the Desert Tortoise Population

Since 1988, Environmental Management has conducted numerous surveys for desert tortoises. The Air Force monitors desert tortoise populations using data collected by researchers and consultants who conduct studies or monitor projects on base. The Air Force uses these data to update database files and various Geographic Information System databases and spreadsheets to facilitate effective management of desert tortoises on base. It will thoroughly analyze and evaluate existing data and provide an up-to-date status of the current estimated distribution,

abundance, and trends of the on-base population of desert tortoises. Currently, the density of the tortoise population on base is unknown.

Long-Term Monitoring of Ecological Trends

The protection, restoration, and conservation of desert habitat are an ongoing management process at Edwards Air Force Base. One key component of this process is the ability to check progress against established benchmarks and use this information to develop effective management strategies that are expected to change over time. As part of the habitat quality analysis studies initiated at Edwards Air Force Base in 1992, the Air Force established 60 long-term monitoring plots to determine baseline conditions of habitat quality and to monitor long-term trends of habitat quality and species diversity. Periodic vegetation and wildlife surveys provide the benchmarks to evaluate environmental change. Each restored area is analyzed in comparison to 3 or 4 study sites with similar habitat characteristics (Reinke 2013). Information obtained from the long-term study plots and natural restoration are also used to determine habitat stability and support the regional desert tortoise recovery effort and the goals and objectives of Edwards Air Force Base's integrated natural resources management plan (Air Force 2008b).

The primary purpose of the integrated natural resources management plan for Edwards Air Force Base is "to implement natural resource management practices that strive to maintain or enhance habitat quality of the installation's natural resources resulting in stabilizing and/or increasing the biodiversity of the desert environment" (Air Force 2008b). The Air Force intends to achieve this purpose through the goals identified in the integrated natural resources management plan, which include but are not limited to monitoring of natural resources, collection of data, management of invasive species, conservation of habitat, and increasing the environmental awareness of all base personnel. The integrated natural resources management plan calls for the meeting of these goals "... in concert with other base organizations, and their programs and plans while ensuring no net loss to the capability of the military mission' (Air Force 2008b).

ANALYTICAL FRAMEWORK FOR THE JEOPARDY AND ADVERSE MODIFICATION DETERMINATIONS

Jeopardy Determination

Section 7(a)(2) of the Endangered Species Act requires that Federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of listed species. "Jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 Code of Federal Regulations 402.02).

The jeopardy analysis in this biological opinion relies on four components: (1) the Status of the Species, which describes the range-wide condition of the desert tortoise, the factors responsible for that condition, and its survival and recovery needs; (2) the Environmental Baseline, which analyzes the condition of the desert tortoise in the action area, the factors responsible for that

condition, and the relationship of the action area to the survival and recovery of the desert tortoise; (3) the Effects of the Action, which determine the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the desert tortoise; and (4) the Cumulative Effects, which evaluate the effects of future, non-federal activities in the action area on the desert tortoise.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed federal action in the context of the current status of the desert tortoise, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the desert tortoise in the wild.

Adverse Modification Determination

Section 7(a)(2) of the Endangered Species Act requires that Federal agencies ensure that any action they authorize, fund, or carry out is not likely to result in the destruction or adverse modification of the critical habitat of listed species. This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 Code of Federal Regulations 402.02. Instead, we have relied on the statutory provisions of the Act to complete the following analysis with respect to critical habitat.

In accordance with policy and regulation, the adverse modification analysis in this biological opinion relies on four components: (1) the Status of Critical Habitat, which describes the range-wide condition of designated critical habitat for the desert tortoise in terms of primary constituent elements, the factors responsible for that condition, and the intended recovery function of the critical habitat overall; (2) the Environmental Baseline, which analyzes the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area; (3) the Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated and interdependent activities on the primary constituent elements and how that will influence the recovery role of the affected critical habitat units; and (4) Cumulative Effects, which evaluates the effects of future non-federal activities in the action area on the primary constituent elements and how that will influence the recovery role of affected critical habitat units.

For purposes of the adverse modification determination, the effects of the proposed Federal action on the critical habitat of the desert tortoise are evaluated in the context of the range-wide condition of the critical habitat, taking into account any cumulative effects, to determine if the critical habitat range-wide would remain functional (or would retain the current ability for the primary constituent elements to be functionally established in areas of currently unsuitable but capable habitat) to serve its intended recovery role for the desert tortoise.

STATUS OF THE DESERT TORTOISE AND CRITICAL HABITAT

Status of the Desert Tortoise

Section 4(c)(2) of the Act requires the Service to conduct a status review of each listed species at least once every five years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review); these reviews, at the time of their completion, provide the most up-to-date information on the range-wide status of the species. For this reason, we are appending the 5-year review of the status of the desert tortoise (Appendix 1; Service 2010b) to this biological opinion and are incorporating it by reference to provide most of the information needed for this section of the biological opinion. The following paragraphs provide a summary of the relevant information in the 5-year review.

In the 5-year review, the Service discusses the status of the desert tortoise as a single distinct population segment and provides information on the Federal Register notices that resulted in its listing and the designation of critical habitat. The Service also describes the desert tortoise's ecology, life history, spatial distribution, abundance, habitats, and the threats that led to its listing (i.e., the 5-factor analysis required by section 4(a)(1) of the Act). In the 5-year review, the Service concluded by recommending that the status of the desert tortoise as a threatened species be maintained.

With regard to the status of the desert tortoise as a distinct population segment, the Service concluded in the 5-year review that the recovery units recognized in the original and revised recovery plans (Service 1994a and 2011a, respectively) do not qualify as distinct population segments under the Service's distinct population segment policy (61 Federal Register 4722; February 7, 1996). We reached this conclusion because individuals of the listed taxon occupy habitat that is relatively continuously distributed, exhibit genetic differentiation that is consistent with isolation-by-distance in a continuous-distribution model of gene flow, and likely vary in behavioral and physiological characteristics across the area they occupy as a result of the transitional nature of, or environmental gradations between, the described subdivisions of the Mojave and Colorado deserts.

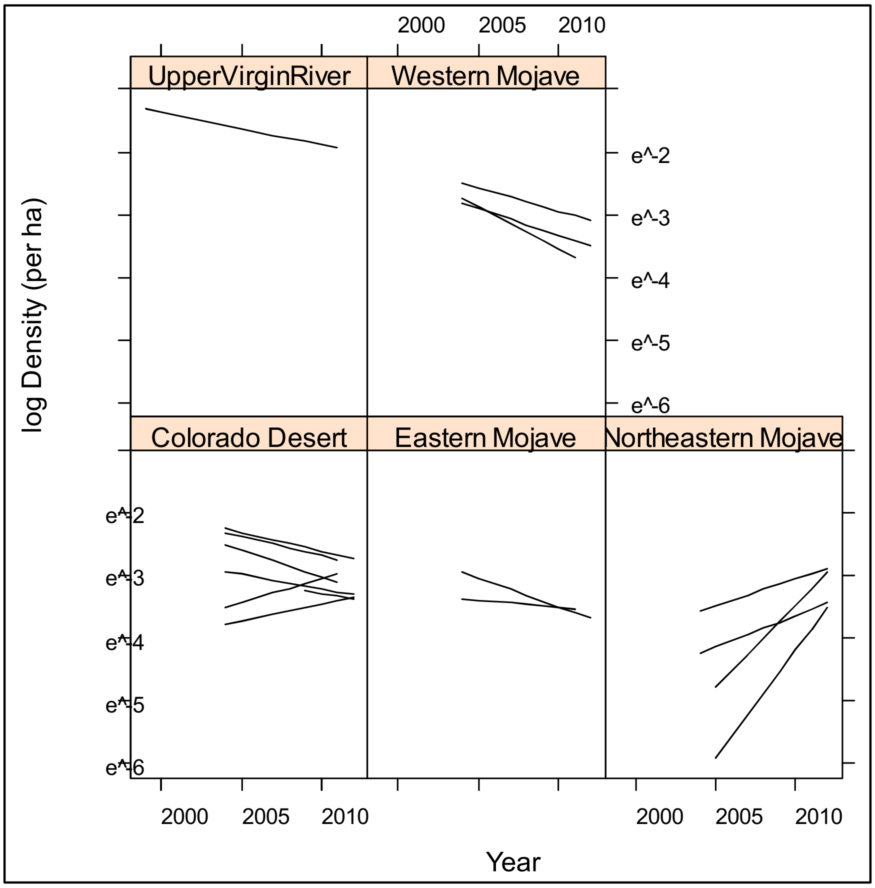
In the 5-year review, the Service summarizes information with regard to the desert tortoise's ecology and life history. Of key importance to assessing threats to the species and to developing and implementing a strategy for recovery is that desert tortoises are long lived, require up to 20 years to reach sexual maturity, and have low reproductive rates during a long period of reproductive potential. The number of eggs that a female desert tortoise can produce in a season is dependent on a variety of factors including environment, habitat, availability of forage and drinking water, and physiological condition. Predation seems to play an important role in clutch failure. Predation and environmental factors also affect the survival of hatchlings.

In the 5-year review, the Service also discusses various means by which researchers have attempted to determine the abundance of desert tortoises and the strengths and weaknesses of those methods. Due to differences in area covered and especially to the non-representative

nature of earlier sample sites, data gathered by the Service's current range-wide monitoring program cannot be reliably compared to information gathered through other means at this time.

The Service provides a summary table of the results of range-wide monitoring, initiated in 2001, in the 5-year review. This ongoing sampling effort is the first comprehensive attempt to determine the densities of desert tortoises across their range. Table 1 of the 5-year review provides a summary of data collected from 2001 through 2007; we summarize data from the 2008 through 2012 sampling efforts in subsequent reports (Service 2012a, 2012b, 2012c, 2012d).

The Service's Desert Tortoise Recovery Office (2014) used annual density estimates to compare a set of models that describe abundance patterns based on linear and quadratic response over time, spatial variation between desert tortoise conservation areas (e.g., national parks, desert wildlife management areas, the Desert Tortoise Natural Area, etc.) and recovery units, and survey team experience. The best model describing range-wide patterns in desert tortoise densities indicated different linear trends in different recovery units (see following figure); an effective training program precluded effects of surveyor experience or the lack thereof. In the original recovery plan for the desert tortoise, the Service (1994a) expected monitoring to detect increasing population trends of no more than 2 percent per year over a 25-year period. The Service has found much larger annual increases (greater than 19.7 percent) in the Northeastern Mojave Recovery Unit since 2004, with the rate of increase apparently resulting from increased survival of adults and subadults moving into the adult size class. The weight of evidence indicates that populations in the other 4 recovery units are declining: Upper Virgin River (-5.1 percent), Eastern Mojave (-5.8 percent), Western Mojave (-9.8 percent), and Colorado Desert (-2.4 percent; however, 2 desert tortoise conservation areas within this unit seem to be increasing).



Allison (2013) also evaluated changes in size distribution of desert tortoises since 2001. In the Western Mojave, Eastern Mojave, and Colorado Desert recovery units, the median size of large individuals has increased, indicating less recruitment of younger (therefore smaller) desert tortoises. In the Western Mojave and Colorado Desert recovery units, the relative number of smaller desert tortoises is about half what it was in 2001. Taken together, these trends suggest fewer small desert tortoises are reaching sexual maturity, which may be explained because they comprise a smaller proportion of the population or possibly because their survival rates are relatively lower than those of adults. Either possibility indicates that smaller size classes, like adults, are affected by ongoing threats; however, because most small desert tortoises die before reaching 180 millimeters in length, we do not know whether the reduced number of small animals has directly contributed to the observed declining trends in adults. For instance, a small increase in adult mortality would have a much larger effect on adult densities. None of these demographic rates have been measured in parallel with this study, so we cannot point to specific demographic rates that are associated with these overall population declines.

In the 5-year review, the Service provides a brief summary of habitat use by desert tortoises; more detailed information is available in the revised recovery plan (Service 2011a). In the absence of specific and recent information on the location of habitable areas of the Mojave Desert, especially at the outer edges of this area, the 5-year review also describes and relies heavily on a quantitative, spatial habitat model for the desert tortoise north and west of the Colorado River that incorporates environmental variables such as precipitation, geology,

heavily on a quantitative, spatial habitat model for the desert tortoise north and west of the Colorado River that incorporates environmental variables such as precipitation, geology, vegetation, and slope and is based on occurrence data of desert tortoises from sources spanning more than 80 years, including data from the 2001 to 2005 range-wide monitoring surveys (Nussear et al. 2009). The model predicts the probability that desert tortoises will be present in any given location; calculations of the amount of desert tortoise habitat in the 5-year review and in this biological opinion use a threshold of 0.5 or greater predicted value for potential desert tortoise habitat. The model does not account for anthropogenic effects to habitat and represents the potential for occupancy by desert tortoises absent these effects.

To begin integrating anthropogenic activities and the variable risk levels they bring to different parts of the Mojave and Colorado deserts, the Service completed an extensive review of the threats known to affect desert tortoises at the time of their listing and updated that information with more current findings in the 5-year review. The review follows the format of the five-factor analysis required by section 4(a)(1) of the Act. The Service described these threats as part of the process of its listing (55 Federal Register 12178; April 2, 1990), further discussed them in the original recovery plan (Service 1994a), and reviewed them again in the revised recovery plan (Service 2011a).

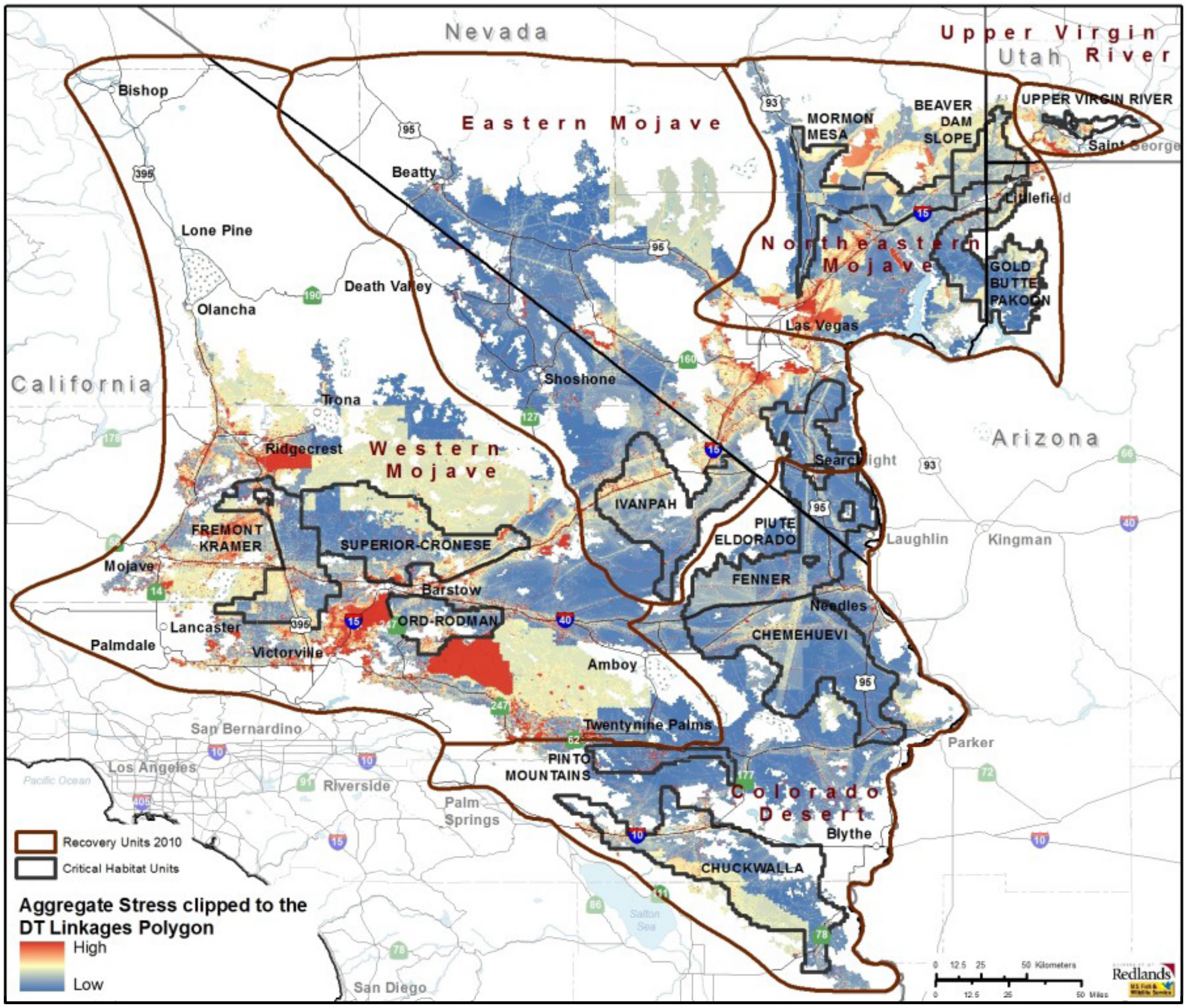
To understand better the relationship of threats to populations of desert tortoises and the most effective manner to implement recovery actions, the Desert Tortoise Recovery Office is developing a spatial decision support system that models the interrelationships of threats to desert tortoises and how those threats affect population change. The spatial decision support system describes the numerous threats that desert tortoises face, explains how these threats interact to affect individual animals and habitat, and how these effects in turn bring about changes in populations. For example, we have long known that the construction of a transmission line can result in the death of desert tortoises and loss of habitat. We have also known that common ravens, known predators of desert tortoises, use the transmission line's pylons for nesting, roosting, and perching and that the access routes associated with transmission lines provide a vector for the introduction and spread of invasive weeds and facilitate increased human access into an area. Increased human access can accelerate illegal collection and release of desert tortoises and their deliberate maiming and killing, as well as facilitate the spread of other threats associated with human presence, such as vehicle use, garbage and dumping, and invasive plants (Service 2011a). Changes in the abundance of native plants because of invasive weeds can compromise the physiological health of desert tortoises, making them more vulnerable to drought, disease, and predation. The spatial decision support system allows us to map threats across the range of the desert tortoise and model the intensity of stresses that these multiple and combined threats place on desert tortoise populations.

The threats described in the listing rule and both recovery plans continue to affect the species. Indirect impacts to desert tortoise populations and habitat occur in accessible areas that interface with human activity. Most threats to the desert tortoise or its habitat are associated with human land uses; research since 1994 has clarified many mechanisms by which these threats act on desert tortoises. As stated earlier, increases in human access can accelerate illegal collection and

release of desert tortoises and deliberate maiming and killing, as well as facilitate the spread of other threats associated with human presence, such as vehicle use, garbage and dumping, and invasive weeds.

Some of the most apparent threats to the desert tortoise are those that result in mortality and permanent habitat loss across large areas, such as urbanization and large-scale renewable energy projects, and those that fragment and degrade habitats, such as proliferation of roads and highways, off-highway vehicle activity, and habitat invasion by non-native invasive plant species. However, we remain unable to quantify how threats affect desert tortoise populations. The assessment of the original recovery plan emphasized the need for a better understanding of the implications of multiple, simultaneous threats facing desert tortoise populations and of the relative contribution of multiple threats on demographic factors (i.e., birth rate, survivorship, fecundity, and death rate; Tracy et al. 2004).

The following map depicts the 12 critical habitat units of the desert tortoise, linkages between conservation areas for the desert tortoise, and the aggregate stress that multiple, synergistic threats place on desert tortoise populations. Conservation areas include designated critical habitat, lands managed by the National Park Service, and other lands managed for the long-term conservation of the desert tortoise (e.g., the Desert Tortoise Natural Area in Kern County, California). The revised recovery plan (Service 2011a) recommended the linkages based on an analysis of least-cost pathways (i.e., areas with the highest potential to support desert tortoises) between conservation areas for the desert tortoise. This map illustrates that, across the range, desert tortoises in areas under the highest level of conservation management remain subject to numerous threats, stresses, and mortality sources.



Since the completion of the 5-year review, the Service has issued several biological opinions that affect large areas of desert tortoise habitat because of numerous proposals to develop renewable energy within its range. These biological opinions concluded that proposed solar plants were not likely to jeopardize the continued existence of the desert tortoise primarily because they were located outside of critical habitat and desert wildlife management areas that contain most of the land base required for the recovery of the species. The proposed actions also included numerous measures intended to protect desert tortoise during the construction of the projects, such as translocation of affected individuals. In aggregate, these projects would result in an overall loss of approximately 37,503 acres of habitat of the desert tortoise. We also predicted that these projects would translocate or kill up to 1,732 desert tortoises; we concluded that most of the individuals in these totals would be juveniles. To date, 372 desert tortoises have been observed during construction of projects; most of these individuals were translocated from work areas, although some desert tortoises have been killed (see appendix 2). The mitigation required by the Bureau and California Energy Commission, the agencies permitting these facilities, will result in the acquisition of private land within critical habitat and desert wildlife management areas and funding for the implementation of various actions that are intended to promote the recovery of

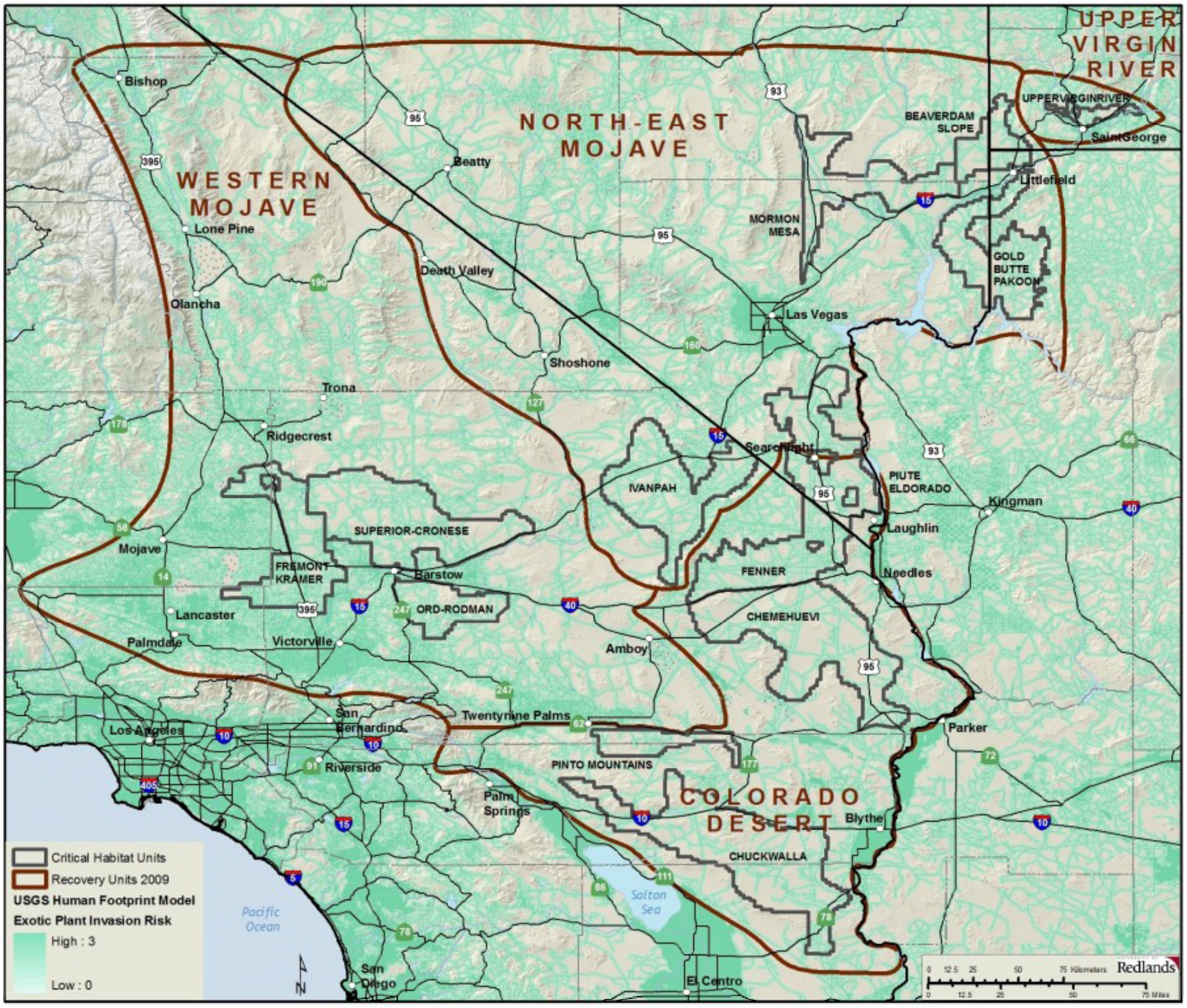
funding for the implementation of various actions that are intended to promote the recovery of the desert tortoise. Although most of these mitigation measures are consistent with recommendations in the recovery plans for the desert tortoise and the Service continues to support their implementation, we cannot assess how desert tortoise populations will respond because of the long generation time of the species.

In addition to the biological opinions issued for solar development within the range of the desert tortoise, the Service (2012e) also issued a biological opinion to the Department of the Army for the use of additional training lands at Fort Irwin. As part of this proposed action, the Army removed approximately 650 desert tortoises from 18,197 acres of the southern area of Fort Irwin, which had been off-limits to training. The Army would also use an additional 48,629 acres that lie east of the former boundaries of Fort Irwin; much of this parcel is either too mountainous or too rocky and low in elevation to support numerous desert tortoises.

The Service also issued a biological opinion to the Marine Corps that considered the effects of the expansion of the Marine Corps Air Ground Combat Center at Twentynine Palms (Service 2012f). We concluded that the Marine Corps' proposed action, the use of approximately 167,971 acres for training, was not likely to jeopardize the continued existence of the desert tortoise. Most of the expansion area lies within the Johnson Valley Off-high Vehicle Management Area.

The incremental effect of the larger actions (i.e., solar development, the expansions of Fort Irwin, and the Marine Corps Air Ground Combat Center) on the desert tortoise is unlikely to be positive, despite the numerous conservation measures that have been (or will be) implemented as part of the actions. The acquisition of private lands as mitigation for most of these actions increases the level of protection afforded these lands; however, these acquisitions do not create new habitat and Federal, State, and privately managed lands remain subject to most of the threats and stresses we discussed previously in this section. Although land managers have been implementing measures to manage these threats, we have been unable, to date, to determine whether the measures have been successful, at least in part because of the low reproductive capacity of the desert tortoise. Therefore, the conversion of habitat into areas that are unsuitable for this species continues the trend of constricting the desert tortoise into a smaller portion of its range.

As the Service notes in the 5-year review (Service 2010b), "(t)he threats identified in the original listing rule continue to affect the (desert tortoise) today, with invasive species, wildfire, and renewable energy development coming to the forefront as important factors in habitat loss and conversion. The vast majority of threats to the desert tortoise or its habitat are associated with human land uses." Oftedal's work (2002 in Service 2010b) suggests that invasive weeds may adversely affect the physiological health of desert tortoises. Current information indicates that invasive species likely affect a large portion of the desert tortoise's range (see following map). Furthermore, high densities of weedy species increase the likelihood of wildfires; wildfires, in turn, destroy native species and further the spread of invasive weeds.



Global climate change is likely to affect the prospects for the long-term conservation of the desert tortoise. For example, predictions for climate change within the range of the desert tortoise suggest more frequent and/or prolonged droughts with an increase of the annual mean temperature by 3.5 to 4.0 degrees Celsius. The greatest increases will likely occur in summer (June-July-August mean increase of as much as 5 degrees Celsius [Christensen et al. 2007 in Service 2010b]). Precipitation will likely decrease by 5 to 15 percent annually in the region with winter precipitation decreasing by up to 20 percent and summer precipitation increasing by up to 5 percent. Because germination of the desert tortoise's food plants is highly dependent on cool-season rains, the forage base could be reduced due to increasing temperatures and decreasing precipitation in winter. Although drought occurs routinely in the Mojave Desert, extended periods of drought have the potential to affect desert tortoises and their habitats through physiological effects to individuals (i.e., stress) and limited forage availability. To place the consequences of long-term drought in perspective, Longshore et al. (2003) demonstrated that even short-term drought could result in elevated levels of mortality of desert tortoises. Therefore, long-term drought is likely to have even greater effects, particularly given that the current fragmented nature of desert tortoise habitat (e.g., urban and agricultural development, Lakes allotments, which are located within critical habitat in the Western Mojave Recovery Unit;

current fragmented nature of desert tortoise habitat (e.g., urban and agricultural development, highways, freeways, military training areas, etc.) will make recolonization of extirpated areas difficult, if not impossible.

The Service notes in the 5-year review that the combination of the desert tortoise's late breeding age and a low reproductive rate challenges our ability to achieve recovery. When determining whether a proposed action is likely to jeopardize the continued existence of a species, we are required to consider whether the action would "reasonably be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 Code of Federal Regulations 402.02). Although the Service does not explicitly address these metrics in the 5-year review, we have used the information in that document to summarize the status of the desert tortoise with respect to its reproduction, numbers, and distribution.

In the 5-year review, the Service notes that desert tortoises increase their reproduction in high rainfall years; more rain provides desert tortoises with more high quality food (i.e., plants that are higher in water and protein), which, in turn, allows them to lay more eggs. Conversely, the physiological stress associated with foraging on food plants with insufficient water and nitrogen may leave desert tortoises vulnerable to disease (Oftedal 2002 in Service 2010b), and the reproductive rate of diseased desert tortoises is likely lower than that of healthy animals. Young desert tortoises also rely upon high-quality, low-fiber plants (e.g., native forbs) with nutrient levels not found in the invasive weeds that have increased in abundance across its range (Oftedal et al. 2002; Tracy et al. 2004). Compromised nutrition of young desert tortoises likely represents an effective reduction in reproduction by reducing the number that reaches adulthood. Consequently, although we do not have quantitative data that show a direct relationship, the abundance of weedy species within the range of the desert tortoise has the potential to negatively affect the reproduction of desert tortoises and recruitment into the adult population.

Data from long-term study plots, which were first established in 1976, cannot be extrapolated to provide an estimate of the number of desert tortoises on a range-wide basis; historic densities in some parts of the desert exceeded 100 adults in a square mile (Desert Tortoise Recovery Office 2014). Using data from the long-term study plots, the Service (2010b) concluded that "appreciable declines at the local level in many areas, which coupled with other survey results, suggest that declines may have occurred more broadly." Other sources indicate that local declines are continuing to occur. For example, surveyors found "lots of dead [desert tortoises]" in the western expansion area of Fort Irwin (Western Mojave Recovery Unit) in 2008 (Fort Irwin Research Coordination Meeting 2008). After the onset of translocation, coyotes killed 105 desert tortoises in Fort Irwin's southern translocation area (Western Mojave Recovery Unit); other canids may have been responsible for some of these deaths. Other incidences of predation were recorded throughout the range of the desert tortoise during this time (Esque et al. 2010). Esque et al. (2010) hypothesized that this high rate of predation on desert tortoises was influenced by low population levels of typical prey for coyotes due to drought conditions in previous years. Recent surveys in the Ivanpah Valley (Eastern Mojave Recovery Unit) for a proposed solar facility detected 31 live desert tortoises and the carcasses of 25 individuals that

had been dead less than 4 years (Ironwood 2011); this ratio of carcasses to live individuals over such a short period of time may indicate an abnormally high rate of mortality for a long-lived animal. In summary, the number of desert tortoises range-wide likely decreased substantially from 1976 through 1990 (i.e., when long-term study plots were initiated through the time the desert tortoise was listed as threatened), although we cannot quantify the amount of this decrease. Additionally, more recent data collected from various sources throughout the range of the desert tortoise suggest that local declines continue to occur (e.g., Bureau et al. 2005, Esque et al. 2010).

The distribution of the desert tortoise has not changed substantially since the publication of the original recovery plan in 1994 (Service 2010b) in terms of the overall extent of its range. Prior to 1994, desert tortoises were extirpated from large areas within their distributional limits by urban and agricultural development (e.g., the cities of Barstow, Lancaster, Las Vegas, St. George, etc.; agricultural areas south of Edwards Air Force Base and east of Barstow), military training (e.g., Fort Irwin, Leach Lake Gunnery Range), and off-road vehicle use (e.g., portions of off-road management areas managed by the Bureau and unauthorized use in areas such as east of California City). Since 1994, urban development around Las Vegas has likely been the largest contributor to habitat loss throughout the range. Desert tortoises have been essentially removed from the 18,197-acre southern expansion area at Fort Irwin (Service 2012e).

The following table depicts acreages of habitat (as modeled by Nussear et al. 2009) within various regions of the desert tortoise's range and of impervious surfaces as of 2006 (Xian et al. 2009). Impervious surfaces include paved and developed areas and other disturbed areas that have zero probability of supporting desert tortoises.

Regions[1]	**Modeled Habitat (acres)**	**Impervious Surfaces within Modeled Habitat**	**Percent of Modeled Habitat that is now Impervious**
Western Mojave	7,582,092	1,864,214	25
Colorado Desert	4,948,900	494,981	10
Northeast Mojave	7,776,934	1,173,025	15
Upper Virgin River	232,320	80,853	35
Total	20,540,246	3,613,052	18

[1]The regions do not correspond to recovery unit boundaries; we used a more general separation of the range for this illustration.

In conclusion, we have used the 5-year review (Service 2010b), revised recovery plan (Service 2011a), and additional information that has become available since these publications to review the reproduction, numbers, and distribution of the desert tortoise. The reproductive capacity of the desert tortoise may be compromised to some degree by the abundance and distribution of invasive weeds across its range; the continued increase in human access across the desert likely continues to facilitate the spread of weeds and further affect the reproductive capacity of the

species. Prior to its listing, the number of desert tortoises likely declined range-wide, although we cannot quantify the extent of the decline; since the time of listing, data suggest that declines continue to occur throughout most of the range, although recent information suggests that densities may have increased slightly in the Northeastern Mojave Recovery Unit. The continued increase in human access across the desert continues to expose more desert tortoises to the potential of being killed by human activities. The distributional limits of the desert tortoise's range have not changed substantially since the issuance of the original recovery plan in 1994; however, desert tortoises have been extirpated from large areas within their range (e.g., Las Vegas, other desert cities). The species' low reproductive rate, the extended time required for young animals to reach breeding age, and the multitude of threats that continue to confront desert tortoises combine to render its recovery a substantial challenge.

Status of Critical Habitat of the Desert Tortoise

The Service designated critical habitat for the desert tortoise in portions of California, Nevada, Arizona, and Utah in a final rule published February 8, 1994 (59 Federal Register 5820). The Service designates critical habitat to identify the key biological and physical needs of the species and key areas for recovery and to focus conservation actions on those areas. Critical habitat is composed of specific geographic areas that contain the biological and physical features essential to the species' conservation and that may require special management considerations or protection. These features, which include space, food, water, nutrition, cover, shelter, reproductive sites, and special habitats, are called the primary constituent elements of critical habitat. The specific primary constituent elements of desert tortoise critical habitat are: sufficient space to support viable populations within each of the six recovery units and to provide for movement, dispersal, and gene flow; sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species; suitable substrates for burrowing, nesting, and overwintering; burrows, caliche caves, and other shelter sites; sufficient vegetation for shelter from temperature extremes and predators; and habitat protected from disturbance and human-caused mortality.

Critical habitat of the desert tortoise would not be able to fulfill its conservation role without each of the primary constituent elements being functional. As examples, having a sufficient amount of forage species is not sufficient if human-caused mortality is excessive; an area with sufficient space to support viable populations within each of the six recovery units and to provide for movement, dispersal, and gene flow would not support desert tortoises without adequate forage species.

The final rule for designation of critical habitat did not explicitly ascribe specific conservation roles or functions to the various critical habitat units. Rather, it refers to the strategy of establishing recovery units and desert wildlife management areas recommended by the recovery plan for the desert tortoise, which had been published as a draft at the time of the designation of critical habitat, to capture the "biotic and abiotic variability found in desert tortoise habitat" (59 Federal Register 5820, see page 5823). Specifically, we designated the critical habitat units to follow the direction provided by the draft recovery plan (Service 1993a) for the establishment of

desert wildlife management areas. The critical habitat units in aggregate are intended to protect the variability that occurs across the large range of the desert tortoise; the loss of any specific unit would compromise the ability of critical habitat as a whole to serve its intended function and conservation role.

Despite the fact that desert tortoises do not necessarily need to move between critical habitat units to complete their life histories, both the original and revised recovery plans highlight the importance of these critical habitat units and connectivity between them for the recovery of the species. Specifically, the revised recovery plan states that "aggressive management as generally recommended in the 1994 Recovery Plan needs to be applied within existing (desert) tortoise conservation areas (defined as critical habitat, among other areas being managed for the conservation of desert tortoises) or other important areas … to ensure that populations remain distributed throughout the species' range …. (Desert tortoise) conservation areas capture the diversity of the Mojave population of the desert tortoise within each recovery unit, conserving the genetic breadth of the species, providing a margin of safety for the species to withstand catastrophic events, and providing potential opportunities for continued evolution and adaptive change …. Especially given uncertainties related to the effects of climate change on desert tortoise populations and distribution, we consider (desert) tortoise conservation areas to be the minimum baseline within which to focus our recovery efforts (pages 34 and 35, Service 2011a)."

The 12 critical habitat units range in area from 85 to 1,595 square miles. However, the optimal reserve size recommended to preserve viable desert tortoise populations was 1,000 square miles (Service 1994a); only 4 critical habitat units meet this threshold. Consequently, for some smaller critical habitat units, their future effectiveness in conserving the desert tortoise is largely dependent on the status of populations immediately adjacent to their boundaries or within intervening linkages that connect these smaller critical habitat units to other protected areas. Although the Service (1994a) recommended the identification of buffer zones and linkages for smaller desert tortoise conservation areas, land management agencies have generally not established such areas.

Population viability analyses indicate that reserves should contain from 10,000 to 20,000 adult desert tortoises to maximize estimated time to extinction (i.e., approximately 390 years, depending on rates of population change; Service 1994a). However, during the three most recent years of monitoring within the critical habitat units, only three (in 2009 and 2010) to five (in 2008) of the critical habitat units met this target (McLuckie et al. 2010; Service 2009, 2012a, 2012b). Some critical habitat units share boundaries and form contiguous blocks (e.g. Superior-Cronese and Fremont-Kramer Critical Habitat Units), and those blocks in California include combined estimated abundances of over 10,000 adult desert tortoises. These blocks are adjacent to smaller, more isolated units (e.g., Ord-Rodman Critical Habitat Unit) that are not currently connected to other protected habitat by preserved habitat linkages.

We did not designate the Desert Tortoise Natural Area and Joshua Tree National Park in California and the Desert National Wildlife Refuge in Nevada as critical habitat because they are "primarily managed as natural ecosystems" (59 Federal Register 5820, see page 5825) and

provide adequate protection to desert tortoises. Since the designation of critical habitat, Congress increased the size of Joshua Tree National Park and created the Mojave National Preserve. A portion of the expanded boundary of Joshua Tree National Park lies within critical habitat of the desert tortoise; portions of other critical habitat units lie within the boundaries of the Mojave National Preserve.

Within each critical habitat unit, both natural and anthropogenic factors affect the function of the primary constituent elements of critical habitat. As an example of a natural factor, in some specific areas within the boundaries of critical habitat, such as within and adjacent to dry lakes, some of the primary constituent elements are naturally absent because the substrate is extremely silty; desert tortoises do not normally reside in such areas. Comparing the acreage of desert tortoise habitat as depicted by Nussear et al.'s (2009) model to the gross acreage of the critical habitat units demonstrates quantitatively that the entire area within the boundaries of critical habitat likely does not support the primary constituent elements; see the following table. The acreage for modeled habitat is for the area in which the probability that desert tortoises are present is greater than 0.5. The acreages of modeled habitat are from Service (2012b); they do not include loss of habitat due to human-caused impacts. The difference between gross acreage and modeled habitat is 653,214 acres; that is, approximately 10 percent of the gross acreage of the designated critical habitat is not considered modeled habitat.

Critical Habitat Unit	**Gross Acreage**	**Modeled Habitat**
Superior-Cronese	766,900	724,967
Fremont-Kramer	518,000	501,095
Ord-Rodman	253,200	184,155
Pinto Mountain	171,700	144,056
Piute-Eldorado	970,600	930,008
Ivanpah Valley	632,400	510,711
Chuckwalla	1,020,600	809,319
Chemehuevi	937,400	914,505
Gold Butte-Pakoon	488,300	418,189
Mormon Mesa	427,900	407,041
Beaver Dam Slope	204,600	202,499
Upper Virgin River	54,600	46,441
Totals	6,446,200	5,792,986

Condition of the Primary Constituent Elements of Critical Habitat

Human activities can have obvious or more subtle effects on the primary constituent elements. The grading of an area and subsequent construction of a building removes the primary constituent elements of critical habitat; this action has an obvious effect on critical habitat. The revised recovery plan identifies human activities such as urbanization and the proliferation of roads and highways as threats to the desert tortoise and its habitat; these threats are examples of activities that have a clear effect on the primary constituent elements of critical habitat.

We have included the following paragraphs from the revised recovery plan for the desert tortoise (Service 2011a) to demonstrate that other anthropogenic factors affect the primary constituent elements of critical habitat in more subtle ways. All references are in the revised recovery plan (i.e., in Service 2011a); we have omitted some information from the revised recovery plan where the level of detail was unnecessary for the current discussion.

> Surface disturbance from [off-highway vehicle] activity can cause erosion and large amounts of dust to be discharged into the air. Recent studies on surface dust impacts on gas exchanges in Mojave Desert shrubs showed that plants encrusted by dust have reduced photosynthesis and decreased water-use efficiency, which may decrease primary production during seasons when photosynthesis occurs (Sharifi et al. 1997). Sharifi et al. (1997) also showed reduction in maximum leaf conductance, transpiration, and water-use efficiency due to dust. Leaf and stem temperatures were also shown to be higher in plants with leaf-surface dust. These effects may also impact desert annuals, an important food source for [desert] tortoises.
>
> [Off-highway vehicle] activity can also disturb fragile cyanobacterial-lichen soil crusts, a dominant source of nitrogen in desert ecosystems (Belnap 1996). Belnap (1996) showed that anthropogenic surface disturbances may have serious implications for nitrogen budgets in cold desert ecosystems, and this may also hold true for the hot deserts that [desert] tortoises occupy. Soil crusts also appear to be an important source of water for plants, as crusts were shown to have 53 percent greater volumetric water content than bare soils during the late fall when winter annuals are becoming established (DeFalco et al. 2001). DeFalco et al. (2001) found that non-native plant species comprised greater shoot biomass on crusted soils than native species, which demonstrates their ability to exploit available nutrient and water resources. Once the soil crusts are disturbed, non-native plants may colonize, become established, and out-compete native perennial and annual plant species (DeFalco et al. 2001, D'Antonio and Vitousek 1992). Invasion of non-native plants can affect the quality and quantity of plant foods available to desert tortoises. Increased presence of invasive plants can also contribute to increased fire frequency.
>
> Proliferation of invasive plants is increasing in the Mojave and Sonoran deserts and is recognized as a substantial threat to desert tortoise habitat. Many species of non-native plants from Europe and Asia have become common to abundant in some areas, particularly where disturbance has occurred and is ongoing. As non-native plant species become established, native perennial and annual plant species may decrease, diminish, or die out (D'Antonio and Vitousek 1992). Land managers and field scientists identified 116 species of non-native plants in the Mojave and Colorado deserts (Brooks and Esque 2002).
>
> Increased levels of atmospheric pollution and nitrogen deposition related to increased human presence and combustion of fossil fuels can cause increased levels of soil nitrogen, which in turn may result in significant changes in plant communities (Aber et

> al. 1989). Many of the non-native annual plant taxa in the Mojave region evolved in more fertile Mediterranean regions and benefit from increased levels of soil nitrogen, which gives them a competitive edge over native annuals. Studies at three sites within the central, southern, and western Mojave Desert indicated that increased levels of soil nitrogen can increase the dominance of non-native annual plants and promote the invasion of new species in desert regions. Furthermore, increased dominance by non-native annuals may decrease the diversity of native annual plants, and increased biomass of non-native annual grasses may increase fire frequency (Brooks 2003).

This summary from the revised recovery plan (Service 2011a) demonstrates how the effects of human activities on habitat of the desert tortoise are interconnected. In general, surface disturbance causes increased rates of erosion and generation of dust. Increased erosion alters additional habitat outside of the area directly affected by altering the nature of the substrate, removing shrubs, and possibly destroying burrows and other shelter sites. Increased dust affects photosynthesis in the plants that provide cover and forage to desert tortoises. Disturbed substrates and increased atmospheric nitrogen enhance the likelihood that invasive species will become established and outcompete native species; the proliferation of weedy species increases the risk of large-scale fires, which further move habitat conditions away from those that are favorable to desert tortoises.

The following paragraphs generally describe how the threats described in the revised recovery plan affect the primary constituent elements of critical habitat of the desert tortoise.

<u>Sufficient space to support viable populations within each of the six recovery units and to provide for movement, dispersal, and gene flow</u>.

In considering the following discussion, bear in mind the information provided previously in this biological opinion regarding the recommended and actual sizes of critical habitat units for the desert tortoise. The original recovery team based the recommended size of desert wildlife management areas on the amount of space required to maintain viable populations. (The recovery plan [Service 1994a] defined conservation areas for the desert tortoise as 'desert wildlife management areas;' we based the boundaries of critical habitat on the recovery team's general recommendation for the desert wildlife management areas.) The current low densities of desert tortoises within critical habitat units exacerbate the difficulties of effecting recovery within these areas.

Urban and agricultural development, concentrated use by off-road vehicles, and other activities of this nature completely remove habitat. Although we are aware of local areas within the boundaries of critical habitat that have been heavily disturbed, we do not know of any areas that have been disturbed to the intensity and extent that this primary constituent element has been compromised. To date, the largest single loss of critical habitat is the use of 18,197 acres of additional training land in the southern portion of Fort Irwin. In our biological opinion for that proposed action (Service 2012e), we stated:

> The proposed action would essentially eliminate the primary constituent elements from approximately 2.40 percent of the Superior-Cronese Critical Habitat Unit; additionally, the conservation role of the remainder of this critical habitat unit and the other critical habitat units has been compromised by substantial human impact on the second and sixth primary constituent elements. However, the protective measures that the Army implemented as part of the proposed action offset, at least to some extent, the adverse effects of the use of the additional training lands in the southern expansion area. Consequently, we have concluded that, although the second and sixth primary constituent elements are not functioning appropriately throughout most of designated critical habitat of the desert tortoise and the proposed action would result in substantial disturbance to 18,197 acres of the Superior-Cronese Critical Habitat Unit, the change in the condition of critical habitat brought about by the Army's proposed action (i.e., use of the southern expansion area for training and implementation of the conservation actions) is not likely to cause an overall decrease in the conservation value and function of the Superior-Cronese Critical Habitat Unit.

The widening of existing freeways likely caused the second largest loss of critical habitat. Despite these losses of critical habitat, which occur in a linear manner, the critical habitat units continue to support sufficient space to support viable populations within each of the six recovery units.

In some cases, major roads likely disrupt the movement, dispersal, and gene flow of desert tortoises. Highways 58 and 395 in the Fremont-Kramer Critical Habitat Unit and Fort Irwin Road in the Superior-Cronese Critical Habitat Unit are examples of large and heavily travelled roads that likely disrupt movement, dispersal, and gene flow. Roads that have been fenced and provided with underpasses may alleviate this fragmentation to some degree; however, such facilities have not been in place for sufficient time to determine whether they will eliminate fragmentation.

The threats of invasive plant species described in the revised recovery plan generally do not result in the removal of this primary constituent element because they do not convert habitat into impervious surfaces, as would urban development.

<u>Sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species.</u>

This primary constituent element addresses the ability of critical habitat to provide adequate nutrition to desert tortoises. As described in the revised recovery plan and 5-year review, grazing, historical fire, invasive plants, altered hydrology, drought, wildfire potential, fugitive dust, and climate change/temperature extremes contribute to the stress of "nutritional compromise." Paved and unpaved roads through critical habitat of the desert tortoise provide avenues by which invasive native species disperse; these legal routes also provide the means by which unauthorized use occurs over large areas of critical habitat. Nitrogen deposition from atmospheric pollution likely occurs throughout all the critical habitat units and exacerbates the

effects of the disturbance of substrates. Because paved and unpaved roads are so widespread through critical habitat, this threat has compromised the conservation value and function of critical habitat throughout the range of the desert tortoise, to some degree. See the Status of the Desert Tortoise section of this biological opinion for a map that depicts the routes by which invasive weeds have access to critical habitat; the routes shown on the map are a subset of the actual number of routes that actually cross critical habitat of the desert tortoise.

Suitable substrates for burrowing, nesting, and overwintering.

Surface disturbance, motor vehicles traveling off route, use of OHV management areas, OHV events, unpaved roads, grazing, historical fire, wildfire potential, altered hydrology, and climate change leading to shifts in habitat composition and location, storms, and flooding can alter substrates to the extent that they are no longer suitable for burrowing, nesting, and overwintering. Erosion caused by these activities can alter washes to the extent that desert tortoise burrows placed along the edge of a wash, which is a preferred location for burrows, could be destroyed. We expect that the area within critical habitat that is affected by off-road vehicle use to the extent that substrates are no longer suitable is relatively small in relation to the area that desert tortoises have available for burrowing, nesting, and overwintering; consequently, off-road vehicle use has not had a substantial effect on this primary constituent element.

Most livestock allotments have been eliminated from within the boundaries of critical habitat. Of those that remain, livestock would compact substrates to the extent that they would become unsuitable for burrowing, nesting, and overwintering only in areas of concentrated use, such as around watering areas and corrals. Because livestock grazing occurs over a relatively small portion of critical habitat and the substrates in most areas within livestock allotments would not be substantially affected, suitable substrates for burrowing, nesting, and overwintering remain throughout most of the critical habitat units.

Burrows, caliche caves, and other shelter sites.

Human-caused effects to burrows, caliche caves, and other shelter sites likely occur at a similar rate as effects to substrates for burrowing, nesting, and overwintering for the same general reasons. Consequently, sufficient burrows, caliche caves, and other shelter sites remain throughout most of the critical habitat units.

Sufficient vegetation for shelter from temperature extremes and predators.

In general, sufficient vegetation for shelter from temperature extremes and predators remains throughout critical habitat. In areas where large fires have occurred in critical habitat, many of the shrubs that provide shelter from temperature extremes and predators have been destroyed; in such areas, cover sites may be a limiting factor. The proliferation of invasive plants poses a threat to shrub cover throughout critical habitat as the potential for larger and more frequent wildfires increases.

In 2005, wildfires in Nevada, Utah, and Arizona burned extensive areas of critical habitat (Service 2010b). Although different agencies report slightly different acreages, the following table provides an indication of the scale of the fires.

Critical Habitat Unit	Total Area Burned (acres)	Percent of the Critical Habitat Unit Burned
Beaver Dam Slope	53,528	26
Gold-Butte Pakoon	65,339	13
Mormon Mesa	12,952	3
Upper Virgin River	10,557	19

The revised recovery plan notes that the fires caused statistically significant losses of perennial plant cover, although patches of unburned shrubs remained. Given the patchiness with which the primary constituent elements of critical habitat are distributed across the critical habitat units and the varying intensity of the wildfires, we cannot quantify precisely the extent to which these fires disrupted the function and value of the critical habitat.

<u>Habitat protected from disturbance and human-caused mortality</u>.

In general, the Federal agencies that manage lands within the boundaries of critical habitat have adopted land management plans that include implementation of some or all of the recommendations contained in the original recovery plan for the desert tortoise. (See pages 70 to 72 of Service 2010b.) To at least some degree, the adoption of these plans has resulted in the implementation of management actions that are likely to reduce the disturbance and human-caused mortality of desert tortoises. For example, these plans resulted in the designation of open routes of travel and the closure (and, in some cases, physical closure) of unauthorized routes. Numerous livestock allotments have been relinquished by the permittees and cattle no longer graze these allotments. Because of these planning efforts, the Bureau's record of decision included direction to withdraw some areas of critical habitat from mineral entry. Because of actions on the part of various agencies, many miles of highways and other paved roads have been fenced to prevent desert tortoises from wandering into traffic and being killed. The Service and other agencies of the Desert Managers Group in California are implementing a plan to remove common ravens that prey on desert tortoises and to undertake other actions that would reduce subsidies (i.e., food, water, sites for nesting, roosting, and perching, etc.) that facilitate their abundance in the California desert (Service 2008).

Despite the implementation of these actions, disturbance and human-caused mortality continue to occur in many areas of critical habitat (which overlap the desert wildlife management areas for the most part and are the management units for which most data are collected) to the extent that the conservation value and function of critical habitat is, to some degree, compromised. For example, many highways and other paved roads in California remain unfenced. Twelve desert tortoises were reported to be killed on paved roads from within Mojave National Preserve in 2011, and we fully expect that desert tortoises are being killed at similar rates on many other roads, although these occurrences are not discovered and reported as diligently as by the

National Park Service. Employees of the Southern California Gas Company reported two desert tortoises in 2011 that were crushed by vehicles on unpaved roads.

Unauthorized off-road vehicle use continues to disturb habitat and result in loss of vegetation within the boundaries of critical habitat (e.g., Coolgardie Mesa in the Western Mojave Recovery Unit); although we have not documented the death of desert tortoises as a direct result of this activity, it likely occurs. Additionally, the habitat disturbance caused by this unauthorized activity exacerbates the spread of invasive plants, which displace native plants that are important forage for the desert tortoise, thereby increasing the physiological stress faced by desert tortoises.

Although the Bureau has approved, through its land use planning processes, the withdrawal of areas of critical habitat from mineral entry, it has not undertaken the administrative procedures to complete withdrawals in all areas. Absent this withdrawal, new mining claims can be filed and further disturbance of critical habitat could occur.

Finally, the Bureau has not allowed the development of solar power plants on public lands within the boundaries of its desert wildlife management areas (which largely correspond to the boundaries of critical habitat). Conversely, the County of San Bernardino is considering the approval of the construction and operation of at least two such facilities within the boundaries of the Superior-Cronese Critical Habitat Unit north of Interstate 15 near the Minneola Road exit.

Summary of the Status of Critical Habitat of the Desert Tortoise

As noted in the revised recovery plan for the desert tortoise and 5-year review (Service 2011a, 2010b), critical habitat of the desert tortoise is subject to landscape level impacts in addition to the site-specific effects of individual human activities. On the landscape level, atmospheric pollution is increasing the level of nitrogen in desert substrates; the increased nitrogen exacerbates the spread of invasive plants, which outcompete the native plants necessary for desert tortoises to survive. As invasive plants increase in abundance, the threat of large wildfires increases; wildfires have the potential to convert the shrubland-native annual plant communities upon which desert tortoises depend to a community with fewer shrubs and more invasive plants. In such a community, shelter and forage would be more difficult for desert tortoises to find. Invasive plants have already compromised the conservation value and function of critical habitat to some degree with regard to the second primary constituent element (i.e., sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species). These effects likely extend to the entirety of critical habitat, given the numerous routes by which invasive plants can access critical habitat and the large spatial extent that is subject to nitrogen from atmospheric pollution. (See maps from previous sections of this biological opinion regarding the extent of the threat of invasive plants and the aggregate stress that multiple threats, including invasive plants, place on critical habitat.)

Critical habitat has been compromised to some degree with regard to the last primary constituent element (i.e., habitat protected from disturbance and human-caused mortality) as a result of the wide variety of human activities that continues to occur within its boundaries. These effects

result from the implementation of discrete human activities and are thus more site-specific in nature.

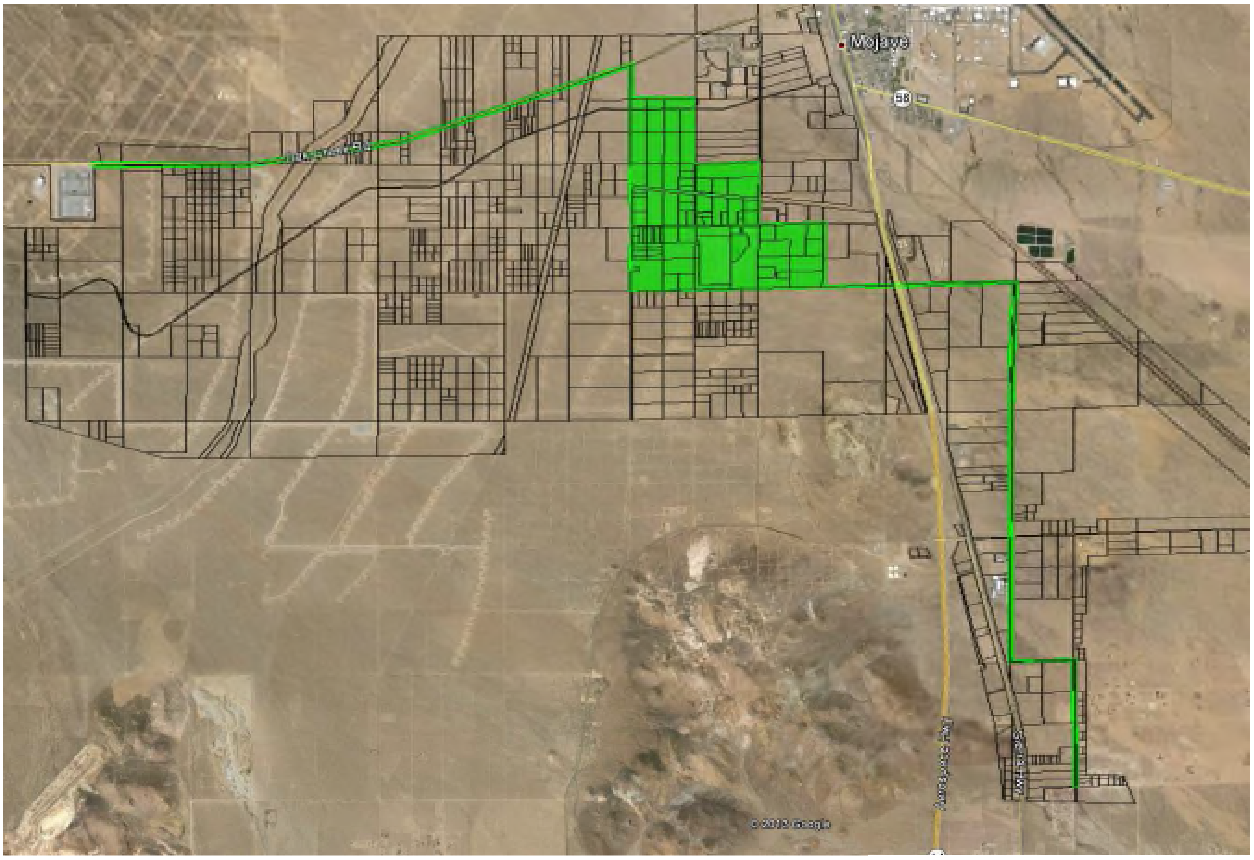
Although the remaining primary constituent elements have been affected to some degree by human activities, these impacts have not, to date, substantially compromised the conservation value and function of the critical habitat units. We have reached this conclusion primarily because the effects are localized and thus do not affect the conservation value and function of large areas of critical habitat.

Land managers have undertaken actions to improve the status of critical habitat. For example, as part of its efforts to offset the effects of the use of additional training maneuver lands at Fort Irwin (Service 2004), the Army acquired the private interests in the Harper Lake and Cronese Lakes allotments, which are located within critical habitat in the Western Mojave Recovery Unit; as a result, cattle have been removed from these allotments. Livestock have been removed from numerous other allotments through various means throughout the range of the desert tortoise. The retirement of allotments assists in the recovery of the species by eliminating disturbance to the primary constituent elements of critical habitat by cattle and range improvements.

ENVIRONMENTAL BASELINE

Action Area

The implementing regulations for section 7(a)(2) of the Act define the "action area" as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 Code of Federal Regulations 402.02). The action area for this biological opinion is the footprint of Edwards Air Force Base, which consists of 307,516 acres, and the route of the gen-tie line from the proposed Oro Verde Solar Project in the northwestern corner of the base to the Windhub Substation, as depicted on the following map (Brewer-Anderson 2013). The precise route for the gen-tie line has not been finalized. The easement for the gen tie line would be 13.9 miles long and up to 110 feet wide. The easement would cover approximately 147 acres.



Habitat Characteristics of the Action Area

The following information provides a summary of the discussion of habitat characteristics from the biological evaluation (Air Force 2008a) and integrated natural resources management plan (Air Force 2008b). The proposed action area is located in the western portion of the Mojave Desert mid-way between the southern end of the Sierra Nevada and the San Bernardino Mountains. Edwards Air Force Base is visually dominated by three dry lakebeds: Rosamond, Rogers, and Buckhorn dry lakes. The area is characterized as high desert with broad expansive valleys bordered by low rocky hills.

The main plant communities on base include creosote bush scrub, saltbush scrub, Joshua tree woodland, and mesquite woodland. The zonal plant communities are primarily based on soil characteristics and elevation; elevation ranges on the base range between 2,500 to 3,300 feet, and topography gradually slopes from west to east. Vegetation in the upland areas on base consists of two main plant communities: creosote bush scrub and Joshua tree woodland. Lowland communities consist of the alkali sink and saltbush communities.

Existing Conditions in the Action Area

In this section, we discuss the anthropogenic and natural conditions in the action area as they relate to desert tortoises and their habitat. Unless we have noted otherwise by citing a biological opinion, the anthropogenic conditions present in the action area were constructed or instituted prior to the listing of the desert tortoise. We summarized the following information from the biological evaluation (Air Force 2008a), integrated natural resources management plan (Air Force 2008b), and communications with Edwards Air Force Base personnel.

Land Use

Edwards Air Force Base is divided into 7 environmental management areas or support zones to better manage the variety of environmental management programs. Figure 3-2 in the integrated natural resource management plan depicts the boundaries of each support zone.

The first zone is a relatively isolated developed area which contains the Air Force Research Laboratory. This area is surrounded by the Precision Impact Range Area in the northeastern portion of the base; desert tortoises are occasionally encountered in this zone.

The second and third zones are composed of main base south and main base north, respectively. Main base south supports areas developed for residential, recreational and commercial use. Main base north is the third zone and supports developed and undeveloped areas; developments in this area support a wide range of operations conducted by the base. Environmental issues in this zone include off-road vehicle areas and the presence of desert tortoise populations.

Zones four and five were developed to support flightline activities. The fourth zone, which is south base, is the original flightline that now primarily functions as a taxiway. Zone five contains the flightline, taxiways and associated hangars. Environmental issues of concern while operating in zone five include desert tortoise and habitat recovery.

The sixth environmental zone consists of the north base and Precision Impact Range Areas. The Precision Impact Range Area covers a large portion of the eastern part of the base and supports low-level aircraft flight-testing, open burn/open detonation facility, and various other facilities; this area also contains desert tortoise critical habitat. The Service (1994b) issued a biological opinion regarding the effects of establishing the Precision Impact Range Area on the desert tortoise and its critical habitat; in this biological opinion, we concluded that the proposed action was not likely to jeopardize the continued existence of the desert tortoise or destroy or adversely modify its critical habitat because of implementation of numerous measures intended to minimize the effects of the proposed action on desert tortoises. The open burn/open detonation area on the Precision Impact Range Area is equipped with desert tortoise exclusion fencing to prevent individuals from entering the facility; due to regular grading, very little vegetation persists within or immediately adjacent to the fenced area of the open burn-open detonation unit. Zone seven comprises undeveloped lands used for a wide variety of base activities including, but not limited to buffer zone around the three lakebeds, aircraft drop zones, shooting ranges,

training area, and lakebed runways. Environmental issues in this management area include desert tortoise, water wells, unpaved roads and emergency landing areas.

The Service has issued biological opinions regarding the effects of establishing, operating, and maintaining a suite of facilities and training areas throughout Edwards Air Force Base on the desert tortoise and its critical habitat. Desert tortoises have been translocated from the areas as necessary to successfully carry out the proposed actions and minimize impacts to desert tortoise. We concluded that the proposed actions were not likely to jeopardize the continued existence of the desert tortoise or destroy or adversely modify its critical habitat; we expect that these actions led to an overall decrease in the number of individuals in these areas.

The type and frequency of use varies greatly between areas. Some areas are heavily used and others remain virtually untouched (Air Force 2008b). Large areas of the base remain undeveloped and accommodate testing activities. A perimeter fence was installed around the base to help conserve desert tortoise habitat, in particular critical habitat. Areas designated as desert tortoise critical habitat require personnel to follow different levels of protection measures based upon the activities planned within that area.

The Air Force has re-vegetated areas disturbed by wildfire burns, unused vehicle routes, abandoned targets, closed borrow pits, closed landfills, and other areas within desert tortoise habitat. As of May 2013, the base has re-vegetated approximately 135 acres of habitat (much of which took place in previously burned areas) (Air Force 2014a). Of this amount, approximately 55 acres are located in critical habitat on the Precision Impact Range Area.

Impacts to natural resources may result in the release of hazardous substances, pollutants, and contaminants into the environment from mission-related activities. The Service issued five biological opinions regarding the effect of the Installation Restoration Program on desert tortoises and its critical habitat; in the biological opinions, we concluded that the proposed actions were not likely to jeopardize the continued existence of the desert tortoise or destroy or adversely modify its critical habitat because a reduction in disturbance is likely to benefit desert tortoises by reducing the amount of habitat that is lost or degraded.

The area between the northwest corner of the base and the Windhub Substation generally supports desert habitat with some scattered residences and businesses. The western end of the gen-tie line crosses through areas that have been developed as wind farms.

Use by Feral and Domestic Livestock

One of the primary historic uses of the land within Edwards Air Force Base included livestock grazing. Although livestock grazing has not legally occurred on base since 1950, portions are still recovering from past overgrazing practices. Illegal sheep grazing occasionally occurred along the northern boundary of the base; installation of boundary fence along the base perimeter has eliminated this problem. Sheep grazing still occurs around the base periphery resulting in some edge effects. Sheep likely occasionally graze in areas along the route of the proposed gen-tie line.

Non-native Species

The processes of grazing, urbanization, agriculture, and road and utility construction have resulted in the introduction of invasive annuals to the native flora, particularly split grass (*Schismus barbatus*), cheat grass (*Bromus tectorum*), and red brome (*Bromus madritensis* ssp. *rubens*). More recently, Sahara mustard (*Brassica tournfortii*) has spread into the western Mojave Desert from the Colorado Desert; it has been observed along U.S. Highway 395 along the edge of the eastern boundary of the base. We expect the abundance of these species to be higher in portions of the base that experienced the most recent livestock grazing.

The abundance and diversity of non-native species in any area vary in relation to the seasonal weather; consequently, the composition of the non-native plant flora may be substantially different from year to year. An overabundance of weedy species likely compromises the nutritional status of desert tortoises, as we discussed in the Status of the Species section of this biological opinion. We do not have specific information on the distribution of non-native species nor on their specific effects on desert tortoises in the action area.

Paved and Unpaved Roads

Highway 395 traverses the northeast corner of Edwards Air Force Base. State Route 58 parallels the northern boundary, with the exception of a small portion that crosses into the base. The construction of Highway 395 and State Route 58 resulted in the loss of viable desert tortoise habitat and poses as a barrier to movement of desert tortoises; we anticipate that at least a few desert tortoises are killed on these roads annually. State Highway 14 crosses the proposed route of the gen-tie line at about its midpoint. Furthermore, we expect that desert tortoise densities adjacent to these major roads are depressed, as discussed by Hoff and Marlow (2002), but we are not aware of surveys that quantify this effect in these specific areas.

The paved roads within the base are focused in areas supporting development and urbanization. The Service (1993b) issued a biological opinion that concluded that the proposed maintenance and repair of roads throughout the base was not likely to jeopardize the continued existence of the desert tortoise or destroy or adversely modify its critical habitat because most of the proposed actions would occur in previously disturbed areas.

In addition to the paved roads within the base, unpaved roads also traverse the action area. One of the primary historic uses of the land within Edwards Air Force Base included off-road and off-highway vehicle activities. Currently, off-road driving is generally prohibited except for within three designated off-road vehicle areas on base (see figure 7-8 in Air Force 2008b). Off-road vehicle area 1 is approximately 100 acres and designated only for use by the Desert Wheels Motorcycle Club. Off-road vehicle area 2 is approximately 15,040 acres located west of military family housing and is jointly used for off-road vehicles, equestrians, and general recreation. Off-road vehicle area 3 is approximately 4,328 acres, including 32 miles of trails, and is only used for non-motorized mountain biking and jogging. No motorized off-road vehicles are permitted in this area. The Service (1996) issued a biological opinion to the Air Force that considered the

effects of establishment and continued use of off-road vehicle area 2 on the desert tortoise. We concluded that the proposed action was not likely to jeopardize the continued existence of the desert tortoise. We expect that recreational use of these areas likely results in the death or injury of desert tortoises.

In July 2002, the Air Force (2008a) had installed approximately 42 miles of desert tortoise exclusion fencing throughout the base. The Air Force fenced roads to reduce injury and mortality to desert tortoises associated with their use. However, the Air Force subsequently determined that the increased fragmentation of habitat and barriers to movement could outweigh the benefit of reducing the injury and mortality of desert tortoises. Edwards Air Force Base currently has approximately 13 miles of desert tortoise exclusion fencing along areas where desert tortoises and threats overlap (Mull 2013b). The Air Force continues to evaluate the need for desert tortoise barrier fencing along roads to maintain connectivity of adjacent habitat.

Since the listing of the desert tortoise, five known desert tortoise deaths have occurred on Edwards Air Force Base; most of the deaths resulted from desert tortoises getting run over by mission-related traffic (Mull 2013c, 2013d). Environmental Management has closed rarely used dirt roads on portions of the base by constructing barriers across those roads; more road closures are planned in the future. New road construction is limited on base. Edwards Air Force Base personnel are encouraged to use existing roads for access throughout the base whenever possible. New roads were created in the past for projects; however, for many years, new projects have been designed to use existing roads as much as possible.

Utilities

Several underground utilities have been constructed in the northern border of the base paralleling State Highway 58. The Service (1995) issued a biological opinion to the Air Force that considered the effects of installing underground communication lines and related facilities at Edwards Air Force Base. We concluded that the proposed action was not likely to jeopardize the continued existence of the desert tortoise.

Large utility poles occur along the eastern boundary paralleling Highway 395. Utility construction on the base from the south and west has also occurred along well-traveled roads. These utilities were installed in the road shoulder or beneath paved or unpaved roads, which presents no new ground disturbance to the habitat adjacent to the road.

The most substantial ongoing effect of utility poles is their ongoing use by common ravens for perching and nesting. The presence of this additional nesting substrate, which allows common ravens to nest far above the reach of ground-dwelling predators, likely contributes substantially to the increase in the number of common ravens in the desert. As previously discussed, common ravens prey on desert tortoises and are likely detrimental to the recovery of the desert tortoise. The need for road maintenance on the utility corridors has left permanent bare areas. Roads along and above utility corridors are occasionally used for maintenance. As we previously

mentioned, the Air Force participates in ongoing re-vegetation efforts which aide in reducing impacts from the establishment of utility corridors.

Status of the Desert Tortoise in the Action Area

The Air Force conducted four major surveys throughout the base between 1991 and 1994 to determine relative density estimates of the desert tortoise. With some exceptions, results of these surveys indicate desert tortoises occur throughout the base, but are not uniformly distributed. Approximately 126 square miles (27 percent) of the base were excluded due to lack of desert tortoise habitat (e.g., dry lake beds, cantonment areas, research facilities, graded targets, housing areas, and other operational areas). The Air Force repeated these density surveys from 2006 through 2007 following the same methodology employed during the 1991 to 1994 surveys.

The Air Force used the total corrected sign method to conduct these surveys. In this methodology, surveyors record the amount of desert tortoise sign (e.g., scat, barrows, etc.) observed while walking transects and then develop a density estimate by calibrating the results against densities on long-term study plots, where the density of desert tortoises had been previously estimated using mark-recapture studies. This technique provides an index of relative density only and is no longer used for several reasons.

The following table summarizes results of surveys conducted from 1991 to 1994 and from 2006 to 2007 (Air Force 2008b, Air Force 2010). Although the absolute numbers may be questionable, the comparison of average densities between the two survey periods seems to indicate that the number of desert tortoises on Edwards Air Force Base has declined.

Survey Period	Density range (individuals per square mile)	Average density (individuals per square mile)
1991-1994	3 to 69	15.9
2006-2007	0 to 58	7.8

Results of the 2006 to 2007 surveys indicate that the relative density of desert tortoises are approximately twice as high near designated critical habitat and within the eastern portion of the base as they are on the west side. The mean relative density of desert tortoises on the east side of the base was 10.3 per square mile; on the west side, the mean relative density was 5.1 desert tortoises per square mile. Fewer desert tortoises are observed along the lakebeds and in the southwestern portions of the base. We added the densities of the areas surveyed and estimated that approximately 2,643 desert tortoises occurred on Edwards Air Force Base at the time of the 2006 and 2007 surveys; because of the variability associated with this methodology, we emphasize that this number represents a very rough estimate.

As we discussed in the Existing Conditions in the Action Area section, we expect that State Routes 58, which borders a portion of the northern edge of the base, and 395, which crosses its

northeastern tip, have likely resulted in a decrease in the numbers of desert tortoises adjacent to these roads. The number of desert tortoises on base has also likely been affected to a degree by the extensive human activity at Edwards Air Force Base that occurred prior to the listing of the species in 1989 (e.g., development of the main base, housing areas, bombing ranges and training areas, etc.; see Appendix B in Air Force 2008a). Finally, desert tortoises on base likely experienced an overall decrease in density as a result of the same factors that affected desert tortoises throughout the western Mojave Desert as we discussed in the Status of the Species section of this biological opinion.

The following table depicts the numbers of desert tortoises that have been killed or moved from harm's way as a result of the Air Force's activities under its active biological opinions (Mull 2013d). As in every action that covers a large area, we expect that the Air Force did not detect all injuries and mortalities. Because the number of desert tortoise mortalities is lower than the number moved from harm's way and substantially lower than the number of observations, we expect that the Air Force's protective measures are generally functioning well and that few animals have been killed or injured as a result of the activities.

Biological opinion	**Total number of Desert Tortoises**		
	Observed	**Mortalities**	**Moved from harm's way**
1-6-91-F-28	3	1	1
1-6-92-F-61	1	0	3
1-8-93-F-5	9	0	2
1-8-93-F-18	0	0	0
1-8-93-F-23	18	0	1
1-8-93-F-32	1	0	1
1-8-93-F-35	0	0	0
1-8-94-F-6	68	2	16
1-8-94-F-19	6	0	0
1-8-94-F-25	0	0	0
1-8-95-F-1	0	0	0
1-8-95-F-6	0	0	0
1-8-95-F-31	1	0	0
1-8-96-F-10	2	0	1
1-8-96-F-45	11	0	0
1-8-96-F-56	0	0	0
1-8-97-F-10	73	2	40
1-8-97-F-38	3	0	0
1-8-98-F-21R	0	0	0
1-8-99-F-58	0	0	0
Total	196	5	65

Total number of desert tortoise observations, mortalities, and moved from harm's way under biological opinions for Edwards Air Force Base from January 1, 1997 to May 31, 2013.

The Air Force is unlikely to find every desert tortoise that dies as a result of its activities. Although we expect that the Air Force's activities have killed more than 5 desert tortoises since its listing, we also expect that the overall number of animals that have died is unlikely to be substantially more than that observed by the Air Force. We have reached this conclusion because the generally low density of desert tortoises on base likely decreases the frequency of interactions between the Air Force's activities and desert tortoises. Additionally, the intensity of monitoring employed by the Air Force and the general high level of awareness of desert tortoises by base personnel in general likely add further protection to individuals of this species.

We expect that desert tortoises occur along the proposed easement for the gen-tie line in low numbers; we are aware of a few desert tortoises that have been detected in the area of the wind farms as a result of surveys conducted in that area. Sheep grazing and unauthorized off-road vehicle use have likely degraded the quality of habitat in this area and resulted in the deaths of desert tortoises. Because of the human activity associated with the residences and businesses, we expect that common ravens are common in this area and exert heavy predation pressure on desert tortoises. We also expect that the presence of State Route 14 has caused a local depression in the number of desert tortoises along the easement.

Status of Critical Habitat of the Desert Tortoise in the Action Area

Approximately 65,554 acres of the Fremont-Kramer Critical Habitat Unit are generally located on the south central and eastern portions of Edwards Air Force Base (Air Force 2008b); this area includes portions of Air Force research facilities and the Precision Impact Range Area. (See figure 5-7 in Air Force 2008b). The Air Force did not provide information on the overall condition of the primary constituent elements of critical habitat within the boundaries of Edwards Air Force Base. In general, we expect that the condition of the primary constituent elements within the installation is similar to that within the remainder of the Fremont-Kramer Critical Habitat Unit. That is, although we expect that the first, third, fourth, and fifth primary constituent elements have been affected to some degree by the Air Force's activities, these impacts have not, to date, substantially compromised the conservation value and function of the critical habitat. We expect that invasive plants have compromised the conservation value and function of critical habitat to some degree with regard to the second primary constituent element (i.e., sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species). Because most of the critical habitat within Edwards Air Force Base experiences fewer disturbances than public lands off base, we expect that the sixth primary constituent element (i.e., habitat protected from disturbance and human caused mortality) has not been appreciably affected by human activities.

The Air Force's activities contribute to the less-than-prime condition of the second primary constituent element. As previously mentioned in the Environmental Baseline, desert tortoise critical habitat is present within the Precision Impact Range Area on base; this area is divided into three management zones that roughly correspond with mission use in each zone. Zone 1 is a designated 4,681-acre area that experiences the heaviest use within the Precision Impact Range Area and critical habitat. Approximately 27,902 acres of critical habitat fall within the area

designated as Zone 2, this area experiences a moderate level of activity that is expected to continue at its current rate. Zone 3 encompasses 31,254 acres of the Precision Impact Range Area. Very little activity occurs within this area. The remaining critical habitat on base that is not associated with the three management zones is 1,717 acres.

The following table shows the total acres of habitat disturbance and re-vegetation efforts in desert tortoise critical habitat under active biological opinions for Edwards Air Force Base. The total acres of disturbance and re-vegetation comprise approximately 0.16 and 0.09 percent of the amount of critical habitat that lies with the boundaries of Edwards Air Force Base, respectively. We adapted the table from Mull (2013d) to include only biological opinions in which habitat disturbance or re-vegetation efforts occurred in areas designated as critical habitat.

Biological opinion	**Total acres of desert tortoise critical habitat disturbed**		**Total acres of re-vegetation**
	Permanent	**Temporary**	
1-8-93-F-23	0.5846	1.59	0
1-8-94-F-6	12.452	79.036	55.45
1-8-94-F-19	0	1.77	0
Total	**13.0366**	**82.396**	**55.45**

Total acres of habitat disturbance and re-vegetation in desert tortoise critical habitat under biological opinions for Edwards Air Force Base from 1 January 1997 – 31 May 2013.

EFFECTS OF THE ACTION

As we described in the Description of the Proposed Action section of this biological opinion, the Air Force and Service evaluated each of the Air Force's proposed activities and listed the aspects of the activity that may affect desert tortoises or their habitat (including critical habitat). In this section of the analysis, we will provide a general description of how these various aspects affect desert tortoises and their habitat (including critical habitat).

After we review the general mechanisms of how the Air Force's activities may affect desert tortoises and their critical habitat, we will analyze the potential effects of the injury or death of up to 5 desert tortoises per year and the loss of up to 5,000 of critical habitat and 15,000 acres outside of critical habitat. The Air Force and Service developed these numbers as thresholds upon which to base the analysis of Future Development in this biological opinion and to provide a trigger for the re-initiation of formal consultation.

Desert tortoises less than 160 millimeters in length (including hatchlings and eggs) are difficult to detect. Surveyors are less likely to detect them than desert tortoises greater than 160 millimeters because hatchlings can take shelter in burrows of all sizes and are difficult to see due to their cryptic nature and their small size. Consequently, we expect that most hatchlings and eggs likely remain in work areas that have been cleared of larger desert tortoises. We anticipate that future activities are likely to result in injury or mortality of small (i.e., less than 160

millimeters in length) desert tortoises because they are more difficult to detect. Because of their cryptic nature and small size, these mortalities have potential to go undetected. We acknowledge that smaller desert tortoises and eggs may be killed during the implementation of the Air Force's activities; however, because they are difficult to detect and because larger individuals are more important for the long-term conservation of the species, we focused our analysis on larger individuals.

Driving Off Roads

Desert Tortoise

In general, the use of vehicles off of roads (paved or unpaved) can injure or kill desert tortoises; vehicles traveling off road can also crush desert tortoise burrows trapping individuals in their collapsed burrows. In contrast to recreational off-highway vehicle use, where numerous vehicles travel off road at high speeds and with little or no regard to natural resources, the Air Force's use of vehicles off road are prohibited under normal conditions, but limited off-road use may be required in emergencies or to support specific mission requirements. Because the off-road activities associated with range-ground operations and the expenditure of ordnance and energetic materials are expected to be infrequent and these activities would be controlled by the Air Force, we expect that use of vehicles off paved or unpaved roads is likely to injure or kill few desert tortoises.

Critical Habitat

In general, the use of vehicles off of roads (paved or unpaved) can destroy plants needed for cover and food, erode and compact substrates, cause proliferation of weeds, and increase in the number and location of wildfires. We do not expect that the use of vehicles off of roads, at the extent likely to be conducted by the Air Force, would have a measurable effect on the first primary constituent element of critical habitat (sufficient space to support viable populations within each of the six recovery units and to provide for movement, dispersal, and gene flow). We have reached this conclusion because the Air Force's use would be infrequent and monitored to the extent that it would not reduce the amount of habitat within critical habitat and prevent movement, dispersal, and gene flow.

The second through fifth primary constituent elements (sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species; suitable substrates for burrowing, nesting, and overwintering; burrows, caliche caves, and other shelter sites; sufficient vegetation for shelter from temperature extremes and predators) are related to the biological and physical aspects of critical habitat. We expect the low level of use of vehicles off roads, which will be appropriately monitored, would not affect the function of these aspects of the desert tortoise's habitat in a measurable manner.

This aspect of the Air Force's activities would minimally affect the sixth primary constituent element (habitat protected from disturbance and human caused mortality) because it would occur infrequently and be monitored.

Driving on Roads

Desert Tortoise

Desert tortoises are generally more easily observed on roads, because of their more even surfaces and lack of plant cover. Roads often allow vehicles to travel at higher speeds, which reduce the likelihood of drivers detecting and avoiding desert tortoises. Rises and turns in roads also decrease the ability of drivers to detect desert tortoises. Along heavily used roads, the number of desert tortoises is depressed for some distance from the edge of the road as a result of road-associated mortality; this distance varies with the level of use of the road. In general, vehicle use is likely to result in at least some mortalities of and injuries to desert tortoises; the extent of the loss is related to the condition of the road, the time of the year when vehicle use occurs, the abundance of desert tortoises, and the awareness of the driver. Even the most careful drivers may occasionally strike a desert tortoise.

To date, most of the reported desert tortoise mortalities that have occurred in the action area resulted from vehicles driving over them on roads during permitted activities (Mull 2013c). Additionally, personnel have moved many more from roadways. The Air Force addresses this threat in its protective measures by posting signs for reduced speed limits where appropriate. We expect this threat to persist throughout the action area.

Critical Habitat

The use of existing roads will not affect the second through fifth primary constituent elements because these physical and biological aspects of critical habitat are no longer present within roads. Roads that experience high levels of traffic can essentially form a barrier to movement, dispersal, and gene flow (first primary constituent element); we do not expect that any roads within Edwards Air Force Base within desert tortoise habitat experience this level of traffic. High levels of traffic may affect the sixth primary constituent element (habitat protected from disturbance and human caused mortality) by increasing the number of desert tortoises that are injured or killed; we do not anticipate that traffic levels in desert tortoise habitat would rise to such levels.

Ground Disturbance

Desert Tortoise

We consider ground disturbance to include any activity where the Air Force's activities disrupt vegetation and substrate through the use of heavy equipment and materials. Desert tortoises may be injured or killed or trapped in their burrows during these activities. Some of the Air Force's

activities may cause negligible amounts ground disturbance. Conversely, the construction of a new target or building may result in ground disturbance over a larger area.

Because the Air Force would use standard and successful measures and experienced staff to avoid injuring or killing desert tortoises during ground-disturbing activities, we expect that relatively few individuals are likely to be injured or killed as a result of ground disturbance.

Critical Habitat

Ground disturbance has the potential to adversely affect all the primary constituent elements of critical habitat. Small amounts of ground disturbance that are temporary in nature would generally affect critical habitat less than larger areas of permanent disturbance, although some indirect effects of smaller projects (e.g., the proliferation of weeds) can extend well beyond the temporal and spatial footprint of a project.

Explosions

Desert Tortoise

Ordnance or other materials associated with explosions could strike a desert tortoise directly. Additionally, unforeseen explosions such as an accidental crash of an unmanned aerial vehicle could also strike and injure or kill a desert tortoise. Such events are likely extremely rare, given the large area of the target sites, the sparse distribution of desert tortoises, and the relatively small area that the explosion would affect. Additionally, the Air Force's standard practice is to check areas within desert tortoise habitat before emergency scheduled explosions occur to remove any desert tortoises that may be present. Some potential exists that large explosions can cause over pressure vibrations that would cause nearby burrows to collapse and trap desert tortoises inside.

Desert tortoises may be injured by noise associated with explosions. Bowles et al. (1999) found that subsonic and supersonic aircraft noise did not elicit substantial responses from desert tortoises. If a desert tortoise were close to a large explosion, however, we expect that the noise would have the potential to cause physical damage to the animal. Because the Air Force inspects areas and would remove desert tortoises before explosions occur, few desert tortoises are likely to be injured or killed by explosions.

The Air Force's use of the target sites and open burn/open detonation facilities can reasonably be expected to start fires under the appropriate conditions. Therefore, we will consider these fires as a likely effect of explosions. Desert tortoises may be burned to death from fires started by weapons testing, open burn/open detonation activities in areas containing vegetation, lightning or aircraft crashes (Air Force 2008a). Fires can injure or kill desert tortoises that are away from their burrows; the use of fire equipment to fight fires could also kill desert tortoises. Larger fires during times of the year and day when desert tortoises are active are more likely to injure or kill desert tortoises than smaller fires when desert tortoises are inactive (i.e., in their burrows). Desert tortoises are less likely to be present in areas that have repeatedly burned, where non-

native grasses predominate; to the extent that at least some fires occur in such areas, the risk of desert tortoises being injured or killed by fire is somewhat reduced.
The Air Force's fire management measures are likely to reduce the potential for fires started at target sites. This measure is protective of desert tortoises because fires can kill desert tortoises that may be above ground.

Critical Habitat

The Air Force's use of explosives would not directly impair the value and function of critical habitat with regard to the first primary constituent element (sufficient space to support viable populations within each of the six recovery units and to provide for movement, dispersal, and gene flow). We have reached this conclusion because the explosions occur in relatively small areas that are used repeatedly. Most explosions would likely occur in areas that have been previously used for such work. However, if a large fire spread from target sites, the potential exists that habitat conditions could be altered to the extent that desert tortoises would no longer traverse such areas.

Large explosions would likely alter the quality and quantity of forage species and the soil conditions to provide for the growth of these species in new target areas (the second primary constituent element); target areas that have been used previously likely no longer support these features. Smaller explosions likely have little or no direct effect on this primary constituent element. As we previously discussed, fire spreading from a target area would likely reduce the value and function of this primary constituent element.

Large explosions likely damage substrates for burrowing, nesting, and overwintering (third primary constituent element) and burrows, caliche caves, and other shelter sites (fourth primary constituent element). Because most explosions would occur in previously used, defined target areas, damage to substrates and shelter sites is likely to be minimal. Fire may affect substrates and shelter sites if it removes sufficient plant cover to increase erosion during storm events. Large explosions would remove vegetation that desert tortoises use for shelter from temperature extremes and predators (the fifth primary constituent element), but generally in a limited area. This adverse effect would be reduced by the use of existing target sites. Fire would affect shelter sites provided by shrubs if it spreads beyond the disturbed target site.

The repeated use of target sites would reduce the potential for explosions to have a measurable effect on the sixth primary constituent element (habitat protected from disturbance and human-caused mortality) because the disturbance and potential for mortality of desert tortoises would be limited to a relatively small portion of critical habitat. Conversely, the creation of new bombing targets in critical habitat requires the Air Force to clear additional lands. As with the other primary constituent elements, fire that spreads beyond disturbed areas around the target sites would increase the adverse effect.

The Air Force's fire management measures likely reduce the potential that fires started at target sites would have a measurable effect on the primary constituent elements of critical habitat of the desert tortoise. One of the primary natural resources management goals of the base's integrated

natural resources management plan is to conserve natural resources in a manner consistent with the military mission and the base's wildland fire management plan by implementing effective suppression of wildland fires and minimizing fire and structural damage to biological resources (Air Force 2008b). Although Edwards Air Force Base has over 200,000 acres of unimproved vegetated terrain, the base has not had a history of a severe fire danger hazard over the past 25 years; lightning is the primary cause of fires on base (Air Force 2008b).

Non-native Plant Species

Desert Tortoise

Vehicles, ground disturbance, fire, and other human activities contribute to the dispersal of non-native plant species. These non-native plants include species that are already present in the California desert and newly introduced species. As we discussed in the Status of the Species and Critical Habitat section of this biological opinion, non-native plants can alter the quality and quantity of plant foods available to desert tortoises and thereby affect their nutritional intake.

Critical Habitat

The spread of non-native plant species may impair the value and function of the first primary constituent element (sufficient space to support viable populations within each of the six recovery units and to provide for movement, dispersal, and gene flow) if they become so widespread and dense that they reduce the ability of desert tortoises to forage over wide areas. This threat is most prominent in the action area where fires have the potential to alter habitat conditions on a large scale.

As we discussed in the Status of Critical Habitat of the Desert Tortoise section of this biological opinion, the function and value of the second primary constituent element (sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species) have been compromised to some degree throughout the range of the desert tortoise. The Air Force's activities, particularly near targets where fires are more likely, may exacerbate this threat.

The spread of non-native plant species is not likely to affect the third and fourth primary constituent element (suitable substrates for burrowing, nesting, and overwintering; burrows, caliche caves, and other shelter sites). We have reached this conclusion because the plants would not generally affect substrates or shelter sites used by desert tortoises.

Non-native plant species can degrade vegetation that desert tortoises use to seek shelter from temperature extremes and predators (the fifth primary constituent element), primarily by supporting larger and more intense fires. Most shrubs in the California desert are not adapted to fire. Once fire kills these shrubs, they are unlikely to return, thus depriving desert tortoises of shelter sites.

Habitat that is degraded by the presence of a large component of non-native species has not been protected from disturbance and human-caused mortality (the sixth primary constituent element). Consequently, spread of non-native plant species has the potential to further degrade the value and function of this primary constituent element.

As we discussed in the Status of the Desert Tortoise section of this biological opinion, current information indicates that invasive species likely affect a large portion of the desert tortoise's range. Non-native species can occur in densities that can increase the risk of fires, which, in turn, destroy native species and may result in future habitat loss. Non-native plant species currently occur throughout Edwards Air Force Base (see Appendix B in 2008b). The Air Force's wildland fire management plan (Appendix H in Air Force 2008b) has potential to reduce the spread of non-native plant species by implementing effective suppression of wildland fires and minimizing fire and structural damage to biological resources. In the event of a wildfire that may affect desert tortoises or their critical habitat, the Air Force and Service would consult under the emergency provisions of section 7(a)(2) of the Endangered Species Act.

Common Ravens

Desert Tortoise

The Air Force has proposed to manage its trash and debris to reduce the attractiveness of Edwards Air Force Base to common ravens. This protective measure would likely be effective in reducing some level of food subsidies to common ravens. We expect that buildings and other structures on the Edwards Air Force Base would continue to provide common ravens with more perching, roosting, and nesting sites than would be found in a natural setting. We also expect that common ravens also derive at least some food and water from the residential area of the installation. Future development may lead to an increase in the number of people using the residential area, which may, in turn, increase the amount of food and water available to common ravens. Any increase in the number of common ravens would likely result in increased predation of desert tortoises.

Critical Habitat

Common ravens do not affect the primary constituent element of critical habitat.

Moving Desert Tortoises from Harm's Way

Desert Tortoise

Some potential exists that capturing desert tortoises to move them from harm's way may cause elevated levels of stress that may render these animals more susceptible to disease. Because the Air Force will use experienced biologists approved by the Service and approved handling techniques, collected desert tortoises are unlikely to experience elevated stress levels. Information from a translocation project at Fort Irwin indicates that translocation of desert

tortoises in that study did not cause a measurable physiological stress response (Drake et al. 2012). In the case of Fort Irwin, the animals were often moved far from their home ranges. Because the Air Force's activities are of a smaller scale, desert tortoises moved from harm's way would likely remain within their home ranges; therefore, we expect that the potential for these animals to be stressed is even lower.

Critical Habitat

Moving desert tortoises from harm's way will not affect critical habitat because this activity primarily involves the transport of individuals a relatively short distance by a biologist who is traveling on foot. Neither the desert tortoises themselves nor the personnel who transport them will affect the primary constituent elements of critical habitat. The construction of artificial burrows would disturb limited areas where annual plants could grow and their supporting substrates; however, this disturbance will not measurably affect the value or function of the primary constituent elements of critical habitat.

Personnel on Foot

Desert Tortoise

Because of their small size, hatchlings and slightly larger desert tortoises could be trampled by foot traffic. Nests are also vulnerable, but their typical location, near the mouth of a burrow, likely protects them to some degree.

We expect that few desert tortoises would be injured or killed in this manner because most Air Force personnel working in desert tortoise habitat will receive specific training, which would increase their awareness of this potential threat. Additionally, we expect that the likelihood of stepping on desert tortoises would generally be low because most activities involving personnel on foot would occur in a relatively limited area of the base and most frequently in situations where the Air Force has conducted surveys to protect desert tortoises.

Critical Habitat

This activity will not affect the primary constituent elements of critical habitat because of the general low level and intensity of use.

Habitat Conversion

Desert Tortoise

Various activities that the Air Force may undertake have the potential to cause habitat conversion. The act of converting habitat from an area that is suitable for desert tortoises into some other environment has the potential to kill the individuals living in that area. Generally, the

heavy equipment that is involved in the conversion of habitat would crush any desert tortoises that are present.

As we have discussed previously in this biological opinion, other factors, such as fire and an overabundance of non-native species can, either together or separately, covert an area of suitable habitat for desert tortoises into something that is far less able to support them. Over time, desert tortoises that are forced to live in such areas are likely to die as a result of starvation; prior to that, their reproductive output would likely be lower because of their poorer physiological condition.

Critical Habitat

Suitable habitat generally is that which contains the primary constituent elements of critical habitat in a functioning condition. In the context of critical habitat, habitat conversion would occur when the amount of disturbance or alteration of a primary constituent element removes its function or value. Any ground-based activity that the Air Force undertakes could potentially disturb or alter, to some degree, the primary constituent elements. As examples, the extensive use of off-road vehicles could decrease the amount of space needed to support a viable population of desert tortoises and to provide for movement, dispersal, and gene flow within the Western Mojave Recovery Unit. Vehicles traveling off roads could decrease the quality and quantity of forage species and the substrate conditions that support the growth of these species and for burrowing; off-road travel could also destroy burrows, caliche caves, and other shelter sites and the perennial vegetation that desert tortoises use for shelter from temperature extremes and predators. Off-road vehicle use would increase the amount of disturbance and human-caused mortality in the area in which it occurred.

Future Development

In this biological opinion, we considered future development to be any activity that the Air Force undertakes for which this biological opinion serves as compliance with the Endangered Species Act. Consequently, we consider the future injury or death of any desert tortoise that may result from an otherwise legal activity to have been analyzed in this biological opinion, provided that it is within the parameters proposed by the Air Force. With regard to habitat and critical habitat, we expect the Air Force to track any loss of habitat or critical habitat caused by any otherwise legal activity it conducts or authorizes. Disturbance resulting from activities that occur in previously disturbed areas that do not support the biological or physical attributes of desert tortoise habitat or in undisturbed natural areas that do not support desert tortoise habitat (e.g., dry lake beds) would not be considered to involve the loss of desert tortoise habitat.

Desert Tortoise

The regulatory definition of "to jeopardize the continued existence of the species" focuses on assessing the effects of the proposed action on the reproduction, numbers, or distribution of the species being considered in the biological opinion. For that reason, we have used those aspects

of the desert tortoise's status as the basis to assess the overall effect of the proposed action on the species.

In the first portion of the Effects of the Action section of this biological opinion, we provided a general description of how the various activities that the Air Force expects to undertake are likely to affect desert tortoises. In the following sections, we will use the proposed re-initiation threshold of five desert tortoises killed in a year to determine how the future operation of Edwards Air Force Base would affect the reproduction, number, and distribution of the desert tortoise. We will then assess the effects of the proposed action on the recovery of the species and whether it is likely to appreciably reduce the likelihood of both the survival and recovery of the desert tortoise. We reach our conclusion regarding whether an action is likely "to jeopardize the continued existence of the species" through an analysis of how a proposed action affects the listed taxon within the action area in relation to the range of the entire listed taxon. For the desert tortoise, this process involves considering the effects at the level of the action area, then at the level of the recovery unit (in this case, the Western Mojave Recovery Unit), and then finally for the range of the listed taxon. Logically, if an aspect of the proposed action is unlikely to cause a measurable effect within the action area, it is unlikely to affect the recovery unit or the remainder of the range.

Reproduction

The reproductive output of individuals of a species is determined in part by the species' breeding ecology, overall abundance of breeding individuals, and the condition of the habitat in which they live. The reproductive output of the desert tortoise is governed by several aspects of its breeding ecology: the delayed onset of breeding, many years of reproduction, high mortality rates of eggs and young, and low mortality rates among adults. If the population of desert tortoises at Edwards Air Force Base was stable or increasing, the loss of five individuals per year to human activities would be unlikely to have a measurable effect on its overall reproductive capacity. The long reproductive life of female desert tortoises and the normally low mortality rates among adult animals are factors that would protect the reproductive output of a population.

The overall abundance of breeding individuals would also influence how the loss of five desert tortoises per year affects their reproductive output at Edwards Air Force Base. In general, desert tortoises occur at low densities in most areas of the base; the highest density is 58 desert tortoises over one square mile. In some areas, their densities are extremely low. The effects of the mortality of five desert tortoises per year within Edwards Air Force Base may negatively affect the amount of reproduction for several reasons. First, the loss of even a small number of individuals in a low-density population could render finding mates more difficult. Second, desert tortoises require from 13 to 20 years to reach sexual maturity. Third, females produce a relatively small number of eggs per year. Fourth, desert tortoises also experience high mortality early in life (including as eggs). Consequently, even moderate downward fluctuations in adult survival rates can result in rapid population declines; slow reproductive rates and high juvenile mortality limit the capacity of populations to increase rapidly after a decline (Service 2011a).

The desert tortoise possesses two safeguards against the loss of reproduction in areas of low population density. First, female desert tortoises can store sperm for several years; this trait provides some hedge against low densities precluding reproduction because females do not need to encounter males every year to produce young. Second, breeding-age desert tortoises would continue to produce young over their long reproductive life; this reproductive output could replace individuals that are killed by the Air Force's activities.

The amount and timing of rainfall in the desert greatly influences the production of native annual plants upon which desert tortoises feed. A high diversity and abundance of annual plants provide desert tortoises with the appropriate quality and quantity of food to persist and to produce eggs. The widespread invasion of non-native annual plants has likely reduced the desert tortoise's ability to obtain the appropriate quality and quantity of forage plants on a consistent basis. Human disturbance of substrates and increased frequency of fires render desert habitat more susceptible to invasion by non-native annual plants. The Air Force does not implement specific measures to control weed infestations that its activities may cause. Consequently the Air Force's activities have the potential to indirectly affect desert tortoise habitat well outside the footprint of areas that it directly disturbs. Some potential exists that non-native plants are already established at Edwards Air Force Base to the degree that the Air Force's activities would not exacerbate the situation. If the Air Force introduced new species of invasive plants during its activities or expanded the area of infestation of invasive species already on base, the quality of desert tortoise habitat would likely further decrease; such a decrease would negatively affect the ability of Edwards Air Force Base to support the reproduction of desert tortoises at the highest levels of productivity.

Based on these factors, we conclude that the loss of five individuals per year to the Air Force's activities is likely to cause a minor depression of reproduction of desert tortoises at Edwards Air Force Base. We acknowledge that all five individuals may not be of reproductive age; the loss of non-reproductive individuals would not have an immediate effect on reproduction. We also acknowledge that the loss of younger animals would reduce their potential recruitment into breeding age individuals.

Our determination with regard to whether a proposed action is likely to jeopardize the continued existence of a species is based on the status of the listed taxon throughout its range and not just within the action area. Consequently, although the loss of five desert tortoises per year at Edwards Air Force Base is likely to cause a minor depression of reproduction of desert tortoises at Edwards Air Force Base, this loss is unlikely to have a measurable effect on the reproduction of desert tortoises within the Western Mojave Recovery Unit or range wide. We have reached this conclusion because Edwards Air Force Base comprises a small portion of the Western Mojave Recovery Unit and an even smaller portion of the species' range. The next section of this analysis provides insight into the numbers of desert tortoises within Edwards Air Force Base, the Western Mojave Recovery Unit, and range wide.

Number

We used the reports on range-wide sampling for the last 3 years (Service 2012b, 2012c, 2012d) to assess how the loss of 5 individuals per year at Edwards Air Force Base would affect the desert tortoise, first within the Western Mojave Recovery Unit (which is where Edwards Air Force Base is located) and then throughout its range. The numbers in the following table are desert tortoises that are greater than 180 millimeters in length that reside in the sampled areas of critical habitat and other desert tortoise conservation areas; because these numbers do not include smaller individuals and desert tortoises that reside outside the sampled areas, we expect that more desert tortoises occur in the Western Mojave Recovery Unit and throughout the range than are represented in this table. Because of the complexity involved with sampling desert tortoises on such a large scale, the changes in numbers from year to year are more likely from sampling error than actual trends or changes in the number of individuals.

Year	Area of Estimate	Number of Desert Tortoises		
		Estimated	Lower 95 Percent CI	Upper 95 Percent CI
2010	Western Mojave	20,264	13,153	31,329
	Range-wide	95,145	77,038	117,511
2011	Western Mojave	21,533	12,600	37,120
	Range-wide	99,568	69,324	143,007
2012	Western Mojave	22,260	19,894	46,735
	Range-wide	71,827	46,685	110,509

To assume the most conservative approach to this analysis, we assumed that the actual numbers of desert tortoises in the Western Mojave Recovery Unit and range wide were the lowest results from these 3 years (12,600 and 46,685). We also assumed that all five desert tortoises that die would be reproductive. These losses amount to approximately 0.04 and 0.01 percent of the number of desert tortoises over 180 millimeters within sampled areas in Western Mojave Recovery Unit and throughout the range; these percentages would decrease even further if we considered all desert tortoises through the entire recovery unit and range.

Because the Air Force's activities would continue over time, we also calculated how the loss of five individuals over a 20-year period would affect desert tortoise populations. The loss of 100 desert tortoises would comprise approximately 0.79 and 0.21 percent of the Western Mojave Recovery Unit and range-wide populations, respectively.

We acknowledge that we cannot predict whether the numbers of desert tortoises at Edwards Air Force Base, within the Western Mojave Recovery Unit, or range wide would change over the next 20 years. If the number of desert tortoises at Edwards Air Force Base decreases, we expect that the Air Force would encounter fewer individuals while it is implementing actions and, therefore, fewer individuals are likelier to die. If more desert tortoises number occur at Edwards Air Force Base in the future, the risk that desert tortoises would die at any given project would increase but the Air Force's proposed protective measures (including a commitment to re-initiate

formal consultation if five are killed in a year) would prevent an appreciable increase in mortalities.

Consequently, based on the best available information, we conclude that the loss of five desert tortoises per year is not likely to appreciably diminish the number of desert tortoises, either within the Western Mojave Recovery Unit or range wide.
We did not discuss the injury of desert tortoises in this section. The implementing regulations for section 7 of the Endangered Species Act at 50 Code of Federal Regulations 402.14(i)(1)(iv) require the Service to specify the procedures to be used to handle or dispose of any individuals of a species that is killed or injured during the implementation of a proposed action that has undergone formal consultation. Consequently, in the Incidental Take Statement - Disposition of Dead or Injured Specimens section of this biological opinion, we will direct the Air Force to take injured desert tortoises to a qualified veterinarian for treatment and to contact us regarding the final disposition any these animals. If they recover from their injuries to the extent that they can be released to the wild, these animals would not be included in the annual count of dead desert tortoises.

Distribution

Edwards Air Force Base occupies approximately 307,516 acres. Of this total, areas of unsuitable habitat (e.g., Buckhorn, Rogers, and Rosamond dry lakes), cantonment areas; research facilities, fenced operational areas, graded targets, other operational areas, and housing cover approximately 80,640 acres. Consequently, approximately 226,876 acres of desert tortoise habitat occur on base.

The Air Force has proposed to re-initiate formal consultation if 20,000 acres of desert tortoise habitat (15,000 acres outside of critical habitat boundaries and 5,000 within the boundaries of critical habitat) are disturbed by future development. This amount of long-term disturbance would comprise up to approximately 9.09 percent of the desert tortoise habitat on Edwards Air Force Base. Previous consultations with the Air Force generally involved numerous actions that affected scattered, relatively small areas of desert tortoise habitat across Edwards Air Force Base. We expect this general pattern to continue. One exception is the Air Force's proposal to allow for the development and operation of a large solar plant in the northwest corner of Edwards Air Force Base. This solar plant may occupy up to 4,000 acres. We do not have information on the final design of the plant at this time; however, some potential exists that the Air Force and operator would not exclude desert tortoises from the entire project area during its operation.

This future development, including the solar plant in the northwestern corner of the base, would reduce the amount of habitat on base and increase, to some degree, the amount of fragmentation on a local scale. Based on the Nussear et al. (2009, using values of 0.5 to 1) model and our calculations (Waln 2010), the Western Mojave Recovery Unit may support up to 10,316 square miles of desert tortoise habitat. Consequently, the proposed action would result in the loss of approximately 0.30 percent of the habitat in the Western Mojave Recovery Unit. (That is,

20,000 acres of disturbance divided by 640 acres per square mile equals 31.25 square miles. 31.25 square miles divided by 10,316 square miles equals 0.00302. 0.00302 multiplied by 100 equals 0.30 percent.) Because the area that may be disturbed at Edwards Air Force Base is a small proportion of the available habitat in the Western Mojave Recovery Unit and because most of the projects that the Air Force undertakes would be relatively small and scattered throughout

the base, we do not expect this loss of habitat to appreciably reduce the distribution of the desert tortoise with regard to the Western Mojave Recovery Unit.

This loss would comprise approximately 0.11 percent of the range-wide distribution of the desert tortoise, which covers approximately 28,417 square miles, using the values of 0.5 to 1 in the Nussear et al. (2009) model and our calculations (Waln 2010). (That is, 31.25 square miles of disturbance divided by 28,417 square miles equals 0.00109. 0.00109 multiplied by 100 equals 0.11 percent.) This loss of habitat is unlikely to appreciably reduce the distribution of the desert tortoise in relation to the range of the listed taxon.

Critical Habitat

We have previously discussed how the various aspects of the Air Force's activities would affect the primary constituent elements of critical habitat, so we will not repeat those analyses here. For the purposes of this analysis, we will assume that any future development within critical habitat is likely to reduce or eliminate the function of the primary constituent elements within the boundaries of that project's area; in terms of the analysis, this assumption likely overstates the effect because some of the primary constituent elements would likely remain after the implementation of at least some of the future actions.

The Air Force anticipates that it may need up to 5,000 acres for the development of new facilities, infrastructure, and new or expanded targets within the approximately 60,800 acres of critical habitat that lie within Edwards Air Force Base. Future development would likely be scattered throughout critical habitat in variously sized parcels. We expect that the Air Force is unlikely to situate larger developments within critical habitat because larger facilities would require more infrastructure support and most of the existing infrastructure is located outside of critical habitat.

The loss or disturbance of 5,000 acres of critical habitat during future development and operations of Edwards Air Force Base has the potential to increase the patchiness of suitable habitat because it could occur in numerous locations. Conversely, we do not expect that scattered development throughout the area of critical habitat within Edwards Air Force Base would measurably affect connectivity, either within or outside of the base. This amount of disturbance would also occupy a relatively small area of the critical habitat on base.

The 5,000 acres comprise approximately 0.96 percent of the Fremont-Kramer Critical Habitat Unit. (That is, 5,000 acres of development divided by 518,000 acres of critical habitat within the Fremont-Kramer Critical Habitat Unit times 100 equals 0.96 percent.) The Service must

consider the effects of a proposed action with regard to the entirety of the 6,446,200 acres of critical habitat that it designated. The 5,000 acres that may be lost or disturbed at Edwards Air Force Base comprise approximately 0.08 percent of critical habitat throughout the range. Because the amount of critical habitat to be lost or disturbed is so small relative to the entire designated area, it is not likely to appreciably diminish the value or function of critical habitat.

Effects on Recovery

Edwards Air Force Base occupies a relatively small portion of the Western Mojave Recovery Unit and an even smaller portion of the range of the desert tortoise. Consequently, the activities that the Air Force conducts on base under consideration in this biological opinion are unlikely to have an appreciable direct effect, either positively or negatively, on the recovery of the desert tortoise. The relatively small number of desert tortoises that we expect the Air Force to kill annually is unlikely to appreciably diminish the ability of the desert tortoise to reach stable or increasing population trends in the future. The Air Force's efforts to re-vegetate disturbed areas, close unneeded roads and unused excavations to reduce mortality of desert tortoises, and install exclusion fence and warning signs along roads to reduce mortality on active roads are likely to promote the conservation of the species within Edwards Air Force Base.

We do not consider the maintenance of head starting pens to raise desert tortoises for release to the wild to be an effective tool for recovery of the species at this time. Mortality rates among wild desert tortoises likely remain too high for desert tortoises released from head-starting pens to result in an expanded population; we also suspect that recruitment of reproductive animals from the ranks of juvenile desert tortoises is not occurring at a sustainable rate in at least some areas of the desert. Various studies have shown that protection of reproductive desert tortoises would contribute far more to the stabilization of population trends than the release of smaller individuals. Until we can improve the survival rate of reproductive desert tortoises (and rate of recruitment of juveniles to a reproductive size), the practice of head starting is highly unlikely to affect an increase in wild populations.

The Readiness and Environmental Protection Initiative would implement an important recovery task for the desert tortoise through the Air Force's acquisition in fee title or by easement lands with critical habitat that lie to the east of the base. These acquisitions would preclude the development of the land; such development is generally detrimental, both directly and indirectly, to the long-term conservation of the desert tortoise.

Overall, the operation of Edwards Air Force Base, as described in this biological opinion, including the development of solar energy facilities, is unlikely to adversely affect the recovery of the desert tortoise. We expect the adverse effects of the Air Force's operations to be relatively minor in relation to the range-wide status of the desert tortoise; the Air Force's on-base programs to restore habitat and reduce the mortality of desert tortoises have the potential to offset, to some degree, the adverse effects of its operations. If the Readiness and Environmental Protection Initiative is successfully implemented over time, the removal of the threat of development on

lands important to the long-term conservation of the desert tortoise would constitute an overall positive effect on recovery.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act. Most of the action area is entirely located within Edwards Air Force Base and is therefore on Federal lands; any future actions will be subject to the consultation requirements of section 7(a)(2) of the Act. A small portion of the action area extends from the northwestern corner of Edwards Air Force Base to the Windhub Substation on Oak Creek Road. We are unaware of any non-federal actions that are reasonably certain to occur in this area. Consequently, the proposed action has no associated cumulative effects.

CONCLUSION

Desert Tortoise

After reviewing its current status, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the desert tortoise. We have reached this conclusion for the following reasons. First, the Air Force has proposed measures to reduce the number of desert tortoises that are likely to be injured or killed in the course of its activities. Second, the few desert tortoises that the Air Force is likely to kill is a minor fraction of the number of desert tortoises range-wide; the loss of these animals is unlikely to measurably affect the number of desert tortoises or reproductive capacity of the listed taxon. Third, the Air Force's efforts to reduce hazards to desert tortoises (e.g., fencing roads and closing excavation in which they can become trapped) are likely to reduce the level of ongoing mortality on base. Fourth, the loss of habitat that is likely to occur during future activities at Edwards Air Force Base will not appreciably reduce the distribution of the desert tortoise.

Critical Habitat of the Desert Tortoise

After reviewing the current status of critical habitat, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the proposed action is not likely to result in the destruction or adverse modification of critical habitat of the desert tortoise. We have reached this conclusion because the amount of critical habitat that is likely to be affected comprises a small portion of the total amount of the critical habitat on Edwards Air Force Base, which itself is a small portion of the larger Fremont-Kramer Critical Habitat Unit and an even smaller portion of critical habitat range wide. Therefore, the amount of disturbance is not likely to compromise the conservation function and value of critical habitat for the desert tortoise.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened wildlife species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to, and not the purpose of, the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this incidental take statement and the avoidance and minimization measures proposed by the Air Force.

The measures described below are non-discretionary; the Air Force must implement these measures during the conduct of its activities or include them as binding conditions of any grant or permit issued to its customers and contractors, as appropriate, for the exemption in section 7(o)(2) to apply. The Air Force has a continuing duty to regulate the activity covered by this incidental take statement. If the Air Force fails to assume and implement the terms and conditions or fails to require its customers and contractors to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. To monitor the impact of incidental take, the Air Force must report the progress of the actions and its impact on the species to the Service as specified in the incidental take statement (50 Code of Federal Regulations 402.14(i)(3)).

The Service anticipates that five desert tortoises per year are likely to be taken, in the form of mortality, as a result of the operation of Edwards Air Force Base. We derived this number through discussions with the Air Force and used it as the basis of our section 7(a)(2) analysis in this biological opinion. This number also serves as a basis for the re-initiation of formal consultation.

We do not expect removing desert tortoises from harm's way during the implementation of the Air Force's activities to result in their injury or mortality. Therefore, we are not including an anticipated amount or extent of this form of take (i.e., capture).

REASONABLE AND PRUDENT MEASURES AND TERMS AND CONDITIONS

The Air Force and Service agreed to several revisions to the proposed action during the course of formal consultation. Because these revisions have been incorporated into the proposed action of

this biological opinion, we have no additional reasonable and prudent measures or terms and conditions.

As described at the beginning of this section, the protective coverage of section 7(o)(2) may lapse if the Air Force does not abide by the protective measures described in this biological opinion. Additionally, the Air Force remains responsible for complying with the provisions of

Reporting Requirements and Disposition of Dead or Injured Specimens sections of this biological opinion.

REPORTING REQUIREMENTS

Pursuant to 50 Code of Federal Regulations 402.14(i)(3), the Air Force must provide a report to the Service that provides details on each desert tortoise that is killed or injured by its activities. In addition to the information that the Air Force will provide to the Service in its annual report, as described in the Administration of the Consultation section of this biological opinion, the report must also include information on any instances when desert tortoises were killed, injured, or handled, the circumstances of such incidents, and any actions undertaken to prevent similar instances from re-occurring. The report must also include a description of the monitoring efforts that occurred during implementation of actions that occur with desert tortoise habitat.

DISPOSITION OF DEAD OR INJURED SPECIMENS

Within 3 days of locating any dead or injured desert tortoises, the Air Force must notify the Ventura Fish and Wildlife Office by telephone (805 644-1766) and by facsimile or electronic mail. The report must include the date, time, and location of the carcass, a photograph, cause of death, if known, and any other pertinent information.

The Air Force must take any injured desert tortoises to a qualified veterinarian for treatment. If any injured desert tortoises survive, the Air Force must contact the Service regarding their final disposition.

Care must be taken in handling dead specimens to preserve biological material in the best possible state for later analysis, if such analysis is needed. The Service will make this determination when the Air Force provides notice that a desert tortoise has been killed by project activities.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The Service recognizes the effort that the Air Force's undertakes to conserve desert tortoises and their habitat. To meet its obligations under section 7(a)(1) of the Act, the Air Force has implemented several actions. For example, the Air Force has provided funds or personnel to conduct line-distance sampling within the Fremont-Kramer Critical Habitat Unit; the data generated by this sampling effort assists the Service in determining population trends across the range of the desert tortoise.

The Air Force is also working in conjunction with nongovernment conservation organizations to acquire lands through the Readiness and Environmental Protection Initiative program. This program supports cost-sharing partnerships authorized by Congress between the military, private conservation groups, and state and local governments to protect military test and training capabilities and conserve land. In the case of Edwards Air Force Base, the Air Force's goal of maintaining open space under the test flight corridors to the north of the base coincides with the Service's goal of conserving critical habitat of the desert tortoise.

The Air Force plans to continue to close and rehabilitate off-highway vehicle routes near the base and within the Fremont-Kramer Critical Habitat Unit to protect regional desert tortoise populations. Within Edwards Air Force Base, the Air Force plans to continue efforts to install desert tortoise barrier fencing and culverts along heavily traveled roads crossing desert tortoise habitat. The Air Force will prioritize the fencing of areas with high densities of desert tortoises or critical habitat; implementation of these actions is contingent upon available funding. To date, the Air Force has installed approximately 13 miles of desert tortoise exclusionary fencing along roads within Edwards Air Force Base.

In addition to these actions, we also recommend that the Air Force:

1. Assist the Service in implementation of the management plan for the common raven, control of feral dogs, management of subsidies for coyotes (*Canis latrans*), and numerous other activities that are intended to reduce the mortality levels of desert tortoises and improve habitat conditions.

2. Mark small desert tortoises from within project sites prior to their movement from harm's way or translocation. This marking would provide some information on their post-project status if they are encountered during future surveys or monitoring efforts. If the Air Force determines that it will include this requirement, we suggest that the authorized biologist contact the Desert Tortoise Recovery Office to ascertain the most appropriate means of marking the animals.

The Service requests notification of the implementation of any conservation recommendations so we may be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats.

RE-INITIATION NOTICE

This concludes formal consultation on operations at Edwards Air Force Base. As provided in 50 CFR 402.16, re-initiation of formal consultation is required where discretionary Federal involvement or control over the action has been retained or is authorized by law and: (1) if the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, the exemption issued pursuant to section 7(o)(2) will have lapsed and any further take would be a violation of section 4(d) or 9. Consequently, we recommend that any operations causing such take cease pending re-initiation.

If you have any questions, please contact Rachel Henry or Ray Bransfield of my staff at (805) 644-1766, extension 333 and 317.

Sincerely,

Stephen P. Henry

Stephen P. Henry
Acting Field Supervisor

Appendices
1. Mojave population of the desert tortoise (*Gopherus agassizii*). 5-year review: summary and evaluation. Available on disk or hard copy by request or at http://ecos.fws.gov/docs/five_year_review/doc3572.DT%205Year%20Review_FINAL.pdf.
2. Solar projects for which the U.S. Fish and Wildlife Service has issued biological opinions or incidental take permits.

References Cited

Allison, L. 2013. Electronic mail. Range-wide population trends. Dated September 9. Desert tortoise monitoring coordinator, Desert Tortoise Recovery Office, U.S. Fish and Wildlife Service. Reno, Nevada.

Bowles, A.E., S. Eckert, L. Starke, E. Berg, L. Wolski, and J. Matesic, Jr. 1999. Effects of flight noise from jet aircraft and sonic booms on hearing, behavior, heart rate, and oxygen consumption of desert tortoises (Gopherus agassizii). Sea World Research Institute, Hubbs Marine Research Center. San Diego, California.

Brewer-Anderson, A. 2013. Electronic mail. Description of the gen-tie line for the Oro Verde Solar Project. Dated December 12. Program Manager, Edwards Air Force Base. Edwards Air Force Base, California.

Bureau of Land Management, County of San Bernardino, and City of Barstow. 2005. Final environmental impact report and statement for the West Mojave Plan; a habitat conservation plan and California Desert Conservation Area Plan amendment. California Desert District, Moreno Valley, California.

Desert Tortoise Recovery Office. 2014. Internal document. Update on monitoring. Dated January 14. U.S. Fish and Wildlife Service. Reno, Nevada.

Drake, K.K., K.E. Nussear, T.C. Esque, A.M. Barber, K.M. Vittum, P.A. Medica, C.R. Tracy, and K.W. Hunter. 2012. Does translocation influence physiological stress in the desert tortoise? Animal Conservation doi:10.1111/j.1469-1795.2012.00549.x.

Esque, T.C., K.E. Nussear, K.K. Drake, A.D. Walde, K.H. Berry, R.C. Averill-Murray, A.P. Woodman, W.I. Boarman, P.A. Medica, J. Mack, J.S. Heaton. 2010. Effects of subsidized predators, resource variability, and human population density on desert tortoise populations in the Mojave Desert, USA. Endangered Species Research 12(2):167-177.

Fort Irwin Research Coordination Meeting. 2008. Meeting notes. Dated October 29.

Hoff, K.V., and R.W. Marlow. 2002. Impacts of vehicle road traffic on desert tortoise populations with consideration of conservation of tortoise habitat in southern Nevada. Chelonian Conservation and Biology 4:449-456.

Ironwood Consulting. 2011. Biological resources technical report – Stateline Solar Farm Project, San Bernardino County, California. Redlands, California.

Longshore, K.M., J.R Jaeger, and M. Sappington. 2003. Desert tortoise (Gopherus agassizii) survival at two eastern Mojave desert sites: death by short-term drought? Journal of Herpetology 37(1):169-177.

McLuckie, A.M., P.G. Emblidge, and R.A. Fridell. 2010. Regional desert tortoise monitoring in the Red Cliffs Desert Reserve, 2009. Publication Number 10-13. Utah Division of Wildlife Resources. Salt Lake City, Utah.

Mull, T. 2013a. Electronic mail regarding re-initiation threshold for the programmatic biological opinion. Dated December 9. Conservation support, Edwards Air Force Base, California.

Mull, T. 2013b. Electronic mail regarding desert tortoise exclusionary fencing currently installed on base. Dated September 5. Conservation support, Edwards Air Force Base, California.

Mull, T. 2013c. Electronic mail regarding desert tortoise mortalities. Dated November 4. Conservation support, Edwards Air Force Base, California.

Mull, T. 2013d. Electronic mail providing acres of disturbance reported for past biological opinions. Dated July 31. Conservation support, Edwards Air Force Base, California.

Nussear, K.E., T.C. Esque, R.D. Inman, L. Gass, K.A. Thomas, C.S.A. Wallace, J.B. Blainey, D.M. Miller, and R.H.Webb. 2009. Modeling habitat of the desert tortoise (Gopherus agassizii) in the Mojave and parts of the Sonoran Deserts of California, Nevada, Utah, and Arizona. U.S. Geological Survey Open-File Report 2009-1102.

Oftedal, O.T., S. Hillard, and D.J. Morafka. 2002. Selective spring foraging by juvenile desert tortoises (Gopherus agassizii) in the Mojave Desert: evidence of an adaptive nutritional strategy. Chelonian Conservation and Biology 4(2):341-352.

Reinke, Dan. 2009. Electronic mail regarding consultation on basewide desert tortoise biological opinion. Dated September 24. Edwards Air Force Base, California.

Reinke, Dan. 2013. Electronic mail regarding measuring restoration efforts. Dated September 3. Edwards Air Force Base, California.

Tracy, C.R., R. Averill-Murray, W.I. Boarman, D. Delehanty, J. Heaton, E. McCoy, D. Morafka, K. Nussear, B. Hagerty, and P. Medica. 2004. Desert Tortoise Recovery Plan Assessment. Prepared for the U.S. Fish and Wildlife Service. Reno, Nevada.

U.S. Air Force. 1994. Edwards Air Force Base revegetation plan. Dated December. Air Force Flight Test Center, Environmental Management Office, Edwards Air Force Base, California.

U.S. Air Force. 2008a. Biological evaluation for the desert tortoise (Gopherus agassizii) for operations and activities at Edwards Air Force Base, California. Dated February. Edwards Air Force Base, California.

U.S. Air Force. 2008b. Integrated natural resources management plan for Edwards Air Force Base, California. Dated August. Edwards Air Force Base, California.

U.S. Air Force. 2010. Desert tortoise relative density estimates at Edwards Air Force Base, California. Dated March. Prepared by Air Force Flight Test Center and U.S. Army Corps of Engineers, Edwards Air Force Base and Sacramento, California.

U.S. Air Force. 2012. Comprehensive base-wide habitat restoration plan. Dated May. Environmental Management Office, Edwards Air Force Base, California.

U.S. Air Force. 2014a. Geographical Information System database: revegetation data of burn sites on Edwards Air Force Base. Environmental Management Office, Edwards Air Force Base, California.

U.S. Air Force. 2014b. Comments on the draft programmatic biological opinion for operations and activities at Edwards Air Force Base, California (8-8-14-F-14). Dated March 4. Edwards Air Force Base, California.

U.S. Fish and Wildlife Service. 1993a. Draft desert tortoise (Mojave population) recovery plan. Portland, Oregon.

U.S. Fish and Wildlife Service. 1993b. Biological opinion for the proposed maintenance and repair of roads on Edwards Air Force Base, California (1-8-93-F-32). Letter to Colonel Vernon P. Saxon, Jr. Vice Commander, Edwards Air Force Base, California. Dated September 22. From Field Supervisor, Ventura Fish and Wildlife Office. Ventura, California.

U.S. Fish and Wildlife Service. 1994a. Desert tortoise (Mojave population) recovery plan. Portland, Oregon.

U.S. Fish and Wildlife Service. 1994b. Biological opinion for the Precision Impact Range Area, Edwards Air Force Base, California (1-8-94-F-6). Letter to Colonel Vernon P. Saxon, Jr. Vice Commander, Edwards Air Force Base, California. Dated March 10. From Field Supervisor, Ventura Fish and Wildlife Office. Ventura, California.

U.S. Fish and Wildlife Service. 1995. Biological opinion for installation of underground communication lines and related facilities on Edwards Air Force Base, California (1-8-95-F-6). Letter to Colonel Vernon P. Saxon, Jr. Vice Commander, Edwards Air Force Base, California. Dated January 9. From Field Supervisor, Ventura Fish and Wildlife Office. Ventura, California.

U.S. Fish and Wildlife Service. 1996. Biological opinion on establishment and continued use of an off-road vehicle area at the Air Force Flight Test Center in Kern, Los Angeles and San Bernardino Counties, California (1-8-96-F-10). Letter to Colonel Vernon P. Saxon, Jr. Vice Commander, Edwards Air Force Base, California. Dated March 27. From Field Supervisor, Ventura Fish and Wildlife Office. Ventura, California.

U.S. Fish and Wildlife Service. 2004. Biological opinion for the proposed addition of maneuver training lands at Fort Irwin, California (1-8-03-F-48). Letter to Colonel Edward Flynn,Fort Irwin, California. Dated March 15. From Field Supervisor, Ventura Fish and Wildlife Office. Ventura, California.

U.S. Fish and Wildlife Service. 2008. Environmental assessment to implement a desert tortoise recovery plan task: reduce common raven predation on the desert tortoise. Ventura Fish and Wildlife Office, Ventura, California.

U.S. Fish and Wildlife Service. 2009. Range-wide monitoring of the Mojave population of the desert tortoise: 2007 annual report. Desert Tortoise Recovery Office. Reno, Nevada.

U.S. Fish and Wildlife Service. 2010a. Desert tortoise – authorized biologist and monitor responsibilities and qualifications. http://www.fws.gov/ventura/species_information/protocols_guidelines/docs/dt/DT%20Auth%20Bio%20qualifications%20statement%2010_20_08.pdf

U.S. Fish and Wildlife Service. 2010b. Mojave population of the desert tortoise (Gopherus agassizii) 5-year review: summary and evaluation. Desert Tortoise Recovery Office. Reno, Nevada.

U.S. Fish and Wildlife Service. 2011a. Revised recovery plan for the Mojave population of the desert tortoise (Gopherus agassizii). U.S. Fish and Wildlife Service, Pacific Southwest Region, Sacramento, California. May 2011.

U.S. Fish and Wildlife Service. 2012a. Range-wide monitoring of the Mojave population of the desert tortoise: 2008 and 2009 annual report. Desert Tortoise Recovery Office. Reno, Nevada.

U.S. Fish and Wildlife Service. 2012b. Range-wide monitoring of the Mojave population of the desert tortoise: 2010 annual report. Desert Tortoise Recovery Office. Reno, Nevada.

U.S. Fish and Wildlife Service. 2012c. Draft range-wide monitoring of the Mojave population of the desert tortoise: 2011 annual report. Desert Tortoise Recovery Office. Reno, Nevada.

U.S. Fish and Wildlife Service. 2012d. Draft range-wide monitoring of the Mojave population of the desert tortoise: 2012 annual report. Desert Tortoise Recovery Office. Reno, Nevada.

U.S. Fish and Wildlife Service. 2012e. Biological opinion on the proposed addition of maneuver training lands at Fort Irwin, California (8-8-11-F-38R). Dated April 27. Letter to Chief of Staff, Headquarters, National Training Center and Fort Irwin, Fort Irwin, California. From Field Supervisor, Ventura Fish and Wildlife Office. Ventura, California.

U.S. Fish and Wildlife Service. 2012f. Biological opinion on the land acquisition and airspace establishment to support large-scale Marine Air Ground Task Force live-fire and maneuver training, Twentynine Palms, California (8-8-11-F-65). Dated July 17. Letter to Commanding General, Marine Corps Air Ground Combat Center, Twentynine Palms, California. From Field Supervisor, Ventura Fish and Wildlife Office. Ventura, California.

U.S. Fish and Wildlife Service. 2014. Draft programmatic biological opinion for operations and activities at Edwards Air Force Base, California (8-8-14-F-14). Dated January 30. Letter to Base Civil Engineer, Edwards Air Force Base, California. From Field Supervisor, Ventura Fish and Wildlife Office. Ventura, California.

Waln, K. 2010. GIS calculations: estimate of modeled desert tortoise habitat within the Western Mojave Recovery Unit from the 1994 recovery plan. Dated February 2. Ventura Fish and Wildlife Office. Ventura, California.

Xian, G., C. Homer, and J. Fry. 2009. Updating the 2001 National Landcover Database land cover classification to 2006 by using Landsat imagery change detection methods. Remote Sensing of Environment 113:1133-1147.

Appendix 2. Solar projects for which the U.S. Fish and Wildlife Service has issued biological opinions or incidental take permits.

The following table summarizes information regarding the proposed solar projects that have undergone formal consultation with regard to the desert tortoise. In the Citations column, a single reference indicates that the acres of desert tortoise habitat and number of desert tortoises are estimates from the biological opinion; when the column includes two citations, the first is for the acres of desert tortoise habitat from the biological opinion and the second is for number of desert tortoises that are known to have been translocated or killed during construction.

Project and Recovery Unit	Acres of Desert Tortoise Habitat	Desert Tortoises Estimated[1]	Desert Tortoises Observed[2]	Citations[3]
Eastern Mojave				
Ivanpah Solar Electric Generating System	3,582	1,136	173	Service 2011a, 2013d
Stateline Solar	1,685	94	-	Service 2013a
Silver State North – NV	685	14	4	Service 2010a, Cota 2013
Silver State South – NV	2,427[4]	122[4]	-	Service 2013a
Amargosa Farm Road – NV	4,350	4	-	Burroughs 2012
Western Mojave				
Abengoa Harper Lake	Primarily in abandoned agricultural fields	4	-	Service 2011b
Chevron Lucerne Valley	516	10	-	Service 2010b
Northeastern Mojave				
Nevada Solar One - NV	400	[5]	[5]	Burroughs 2012, 2014
Copper Mountain North - NV	1,400	30[5]	30[5]	Burroughs 2012, 2014
Copper Mountain - NV	380	[5]	[5]	Burroughs 2012, 2014
Moapa K Road Solar - NV	2,141	186	157	Service 2012, Burroughs 2013
Colorado				
Genesis	1,774	8	0	Service 2010c, Fraser 2014
Blythe	6,958	30	-	Service 2010d
Desert Sunlight	4,004	56	7	Service 2011c, Fraser 2014
McCoy	4,533	15	-	Service 2013b
Desert Harvest	1,300	5	-	Service 2013c
Rice	1,368	18	1	Service 2011d, Fraser 2014
Total	**37,503**	**1,732**	**372**	

1. The numbers in this column are not necessarily comparable because the methodologies for estimating the numbers of desert tortoises occasionally vary between projects.
2. This column reflects the numbers of desert tortoises observed within project areas. It includes translocated animals and those that were killed by project activities. Project activities may result in the deaths of more desert tortoises than are found.
3. The first citation in this column is for the biological opinion or incidental take permit and is the source of the information for both acreage and the estimate of the number of desert tortoises. The second is for the number of desert tortoises observed during construction of the project; where only one citation is present, construction has not begun or data are unavailable at this time.
4. These numbers include Southern California Edison's Primm Substation and its ancillary facilities.
5. These projects occurred under the Clark County Multi-species Habitat Conservation Plan; the provisions of the habitat conservation plan do not require the removal of desert tortoises. We estimate that all three projects combined will affect fewer than 30 desert tortoises.

The Service completed consultation on the Calico and Palen projects. The applicant for the Calico project, which was located in the Western Mojave Recovery Unit, has abandoned the project and the Bureau has withdrawn the request for consultation (Bureau 2013). For the Palen project, which is located in the Colorado Desert, BrightSource Energy acquired the project from its former owner and proposed to use power tower technology. The California Energy Commission denied the application but will allow BrightSource Energy to re-apply if it can resolve the issues the California Energy Commission raised. Because of the change in technology, the Bureau re-initiated formal consultation with the Service. As of the March 7, 2014, the Service and Bureau have not completed formal consultation on this project; consequently, we have removed it from the table.

Appendix 2: References Cited

Bureau of Land Management. 2013. Withdrawal of request for re-initiation of consultation for the Calico Solar Project. Dated August 09. Memorandum to Field Supervisor, Ventura Fish and Wildlife Office, Ventura, California. From Deputy State Director, California State Office. Sacramento, California.

Burroughs, M. 2012. Electronic mail. Information on solar projects in desert tortoise habitat in Nevada for which the Service has issued biological opinions. Dated April 26. Fish and Wildlife Biologist, Southern Nevada Field Office, U.S. Fish and Wildlife Service. Las Vegas, Nevada.

Burroughs, M. 2013. Electronic mail. Comments on the draft biological opinion for the Stateline and Silver State Solar South projects, San Bernardino County, California, and Clark County, Nevada (Stateline: 2800(P), CACA-048669, CAD090.01; Silver State South: 6840 (NV-052)) (Stateline: 8-8-13-F-43; Silver State South: 84320-2010-F-0208-R003). Dated September 23. Biologist, Southern Nevada Field Office, U.S. Fish and Wildlife Service. Las Vegas, Nevada.

Burroughs, M. 2014. Electronic mails. Status of solar projects in Nevada. Dated January 27. Biologist, Southern Nevada Field Office, U.S. Fish and Wildlife Service. Las Vegas, Nevada.

Cota, M. 2013. Electronic mail. Comments on the draft biological opinion for the Stateline and Silver State Solar South projects, San Bernardino County, California, and Clark County, Nevada (Stateline: 2800(P), CACA-048669, CAD090.01; Silver State South: 6840 (NV-052)) (Stateline: 8-8-13-F-43; Silver State South: 84320-2010-F-0208-R003). Dated September 18. Wildlife biologist, Pahrump Field Office, Bureau of Land Management. Las Vegas, Nevada.

Davis, D. 2013. Electronic mail. Number of desert tortoises being monitored as control animals for the Ivanpah Solar Electric Generating System. Dated September 9. Senior Compliance Manager, BrightSource Energy, Inc. Oakland, California.

Fraser, J. 2014. Electronic mails. Status of solar projects in Colorado Desert. Dated January 27 and 28. Biologist, Palm Springs Fish and Wildlife Office, U.S. Fish and Wildlife Service. Palm Springs, California.

U.S. Fish and Wildlife Service. 2010a. Formal consultation for the Silver State Solar Project (NextLight Renewable Power, LLC), Clark County, Nevada. File No. 84320-2010-F-0208. Dated September 16. Memorandum to Field Manager, Pahrump Field Office, Bureau of Land Management, Las Vegas, Nevada. From State Supervisor, Nevada Fish and Wildlife Office. Reno, Nevada.

U.S. Fish and Wildlife Service. 2010b. Biological opinion on the Lucerne Valley Chevron Solar Project, San Bernardino County, California (8-8-10-F-6). Memorandum to Field Manager, Barstow Field Office, Bureau of Land Management, Barstow, California. Dated June 10. From Field Supervisor, Ventura Fish and Wildlife Office. Ventura, California.

U.S. Fish and Wildlife Service. 2010c. Biological opinion on the Genesis Solar Energy Project, Riverside County, California. Memorandum to Field Manager, Palm Springs South Coast Field Office, Bureau of Land Management, Palm Springs, California. Dated November 2. From Field Supervisor, Carlsbad Fish and Wildlife Office. Carlsbad, California.

U.S. Fish and Wildlife Service. 2010d. Biological opinion on the Blythe Solar Power Plant, Riverside County, California. Memorandum to Field Manager, Palm Springs South Coast Field Office, Bureau of Land Management, Palm Springs, California. Dated October 8. From Field Supervisor, Carlsbad Fish and Wildlife Office. Carlsbad, California.

U.S. Fish and Wildlife Service. 2011a. Biological opinion on BrightSource Energy's Ivanpah Solar Electric Generating System Project, San Bernardino County, California [CACA-48668, 49502, 49503, 49504] (8-8-10-F-24R). Dated June 10. Memorandum to District Manager, California Desert District, Bureau of Land Management, Moreno Valley, California. From Field Supervisor, Ventura Fish and Wildlife Office. Ventura, California.

U.S. Fish and Wildlife Service. 2011b. Biological opinion on the Mojave Solar, LLC's Mojave Solar Project, San Bernardino County, California (8-8-11-F-3). Letter sent to Director of Environmental Compliance, Loan Guarantee Program, Department of Energy, Washington, D.C. and Field Manager, Barstow Field Office, Bureau of Land Management, Barstow, California. Dated March 17. From Field Supervisor, Ventura Fish and Wildlife Office. Ventura, California.

U.S. Fish and Wildlife Service. 2011c. Biological opinion on the Desert Sunlight Solar Farm Project, Riverside County, California. Memorandum to Field Manager, Palm Springs South Coast Field Office, Bureau of Land Management, Palm Springs, California. Dated July 6. From Field Supervisor, Carlsbad Fish and Wildlife Office. Carlsbad, California

U.S. Fish and Wildlife Service. 2011d. Biological opinion on the Rice Solar Energy Project, Riverside County, California. Dated July 27. Letter to John Holt, Environmental Manager, Desert Southwest Customer Service Region Western Area Power Administration, Phoenix, Arizona. From Jim A. Bartel, Field Supervisor, Carlsbad Fish and Wildlife Office. Carlsbad, California.

U.S. Fish and Wildlife Service. 2012. Biological opinion for the K Road Moapa Solar Project, Moapa River Indian Reservation, Clark County, Nevada. Memorandum to Superintendent, Southern Paiute Agency, Bureau of Indian Affairs. St. George, Utah. Dated March 7. From State Supervisor, Nevada Fish and Wildlife Office. Reno, Nevada.

U.S. Fish and Wildlife Service. 2013a. Biological opinion for the Stateline Solar and Silver State Solar South Projects, San Bernardino County, California, and Clark County, Nevada. Dated September 30. Memorandum to Field Manager, Needles Field Office, Bureau of Land Management, Needles California, and Assistant Field Manager, Las Vegas Field Office, Bureau of Land Management, Las Vegas, Nevada. From Acting Field Supervisor, Ventura Fish and Wildlife Office. Ventura, California.

U.S. Fish and Wildlife Service. 2013b. Biological opinion on the McCoy Solar Power Project, Riverside County, California. Dated March 6. Memorandum to Field Manager, California Desert District Office, Bureau of Land Management, Moreno Valley, California. From Field Supervisor, Carlsbad Fish and Wildlife Office. Carlsbad, California.

U.S. Fish and Wildlife Service. 2013c. Biological opinion on the Desert Harvest Solar Project, Riverside County, California [CACA 044919]. Dated January 15. Memorandum to Field Manager, Palm Springs-South Coast Field Office, Bureau of Land Management, Moreno Valley, California. From Field Supervisor, Carlsbad Fish and Wildlife Office. Carlsbad, California.

U.S. Fish and Wildlife Service. 2013d. Internal briefing for the Secretary of the Interior regarding the Ivanpah Solar Electric Generating System. Dated June 25. Ventura Fish and Wildlife Office. Ventura, California

APPENDIX A
PUBLIC COMMENTS AND RESPONSES TO DRAFT EA

APPENDIX A

PUBLIC COMMENTS AND RESPONSES TO THE DRAFT EA

Relevant federal and state resource agencies, Native American tribes, and local document repositories on the project mailing list have been sent notification on the Proposed Action and Alternatives. The Draft EA was filed with the California Office of Planning and Research (State Clearinghouse) for distribution to appropriate State and regional agencies for review and comment. One letter from the RWQCB was received. This letter, as well as the response to the letter, are provided in this appendix.

May 5, 2017

File: Environmental Doc Review,
San Bernardino, Kern, and Los
Angeles Counties

Gary Hatch
United States Air Force Department of Defense
Edwards Air Force Base
305 E. Popson Ave.
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Comments on the Draft Environmental Assessment for Implementation of the Installation Development Plan at Edwards Air Force Base, Kern County, State Clearinghouse No. 2017044001

California Regional Water Quality Control Board, Lahontan Region (Water Board) staff received the Environmental Assessment and Finding of No Significant Impact (EA/FONSI) on the above-referenced plan (Plan) on April 18, 2017. The EA/FONSI was prepared by the United States Air Force Department of Defense (USAF) to evaluate potential impacts and required mitigation associated with implementation of the proposed Installation Development Plan. The Plan is a planning tool for demolition, construction and modification of facilities and infrastructure identified at EAFB as critical in supporting current and projected mission needs; subsequent and focused environmental review will occur as individual projects are proposed to implement elements of the Plan. Alternatives evaluated included high intensity development, basic maintenance, and no action. The EA/FONSI was circulated by the USAF in compliance with the provisions of NEPA in order to solicit input and considerations for potential additional environmental analysis and compliance with any other applicable regulations.

Water Board staff, acting as a responsible agency, is providing these comments to specify the scope and content of the environmental information germane to our statutory responsibilities pursuant to California Environmental Quality Act (CEQA) Guidelines, California Code of Regulations, title 14, section 15096. We thank the USAF for considering our comments and our position with respect to protecting and maintaining water quality in the Lahontan Region. Our comments are outlined below.

Water Board's Authority

All groundwater and surface waters are considered waters of the State. Surface waters include streams, lakes, ponds, and wetlands, and may be ephemeral, intermittent, or perennial. All waters of the State are protected under California law. State law assigns

responsibility for protection of water quality in the Lahontan Region to the Lahontan Water Board. Some waters of the State are also waters of the U.S. The Federal Clean Water Act (CWA) provides additional protection for those waters of the State that are also waters of the U.S.

The *Water Quality Control Plan for the Lahontan Region* (Basin Plan) contains policies that the Water Board uses with other laws and regulations to protect the quality of waters of the State within the Lahontan Region. The Basin Plan sets forth water quality standards for surface water and groundwater of the Region, which include designated beneficial uses as well as narrative and numerical objectives which must be maintained or attained to protect those uses. The Basin Plan can be accessed via the Water Board's web site at http://www.waterboards.ca.gov/lahontan/water_issues/programs/basin_plan/references.shtml.

Specific Issues to be Considered

We recommend the following be included as part of the proposed Plan and considered in subsequent project-level environmental review.

1. The State Water Board or the Regional Water Board (collectively referred to as Water Boards) may need to issue discretionary permits for implementation of the Plan, we request that project-level environmental documents prepared in association to the Plan comply with and satisfy the requirements of both NEPA and CEQA. The Water Boards cannot take a discretionary action or issue a permit until CEQA has been satisfied.

2. Plan areas may include marked (blue line) and unmarked surface waters, all of which are waters of the State. Surface waters include, but are not limited to, drainages, streams, washes, ponds, pools, or wetlands, and may be permanent or intermittent. Waters of the State may include waters determined to be jurisdictional waters of the U.S. by the U.S. Army Corps of Engineers (USACE).

3. The beneficial uses of water resources in the Lahontan Region are listed either by watershed (for surface waters) or by groundwater basin (for groundwater) in Chapter 2 of the Basin Plan. Project-level environmental documents should identify and list the beneficial uses of the water resources within the Plan area and include an analysis of the potential impacts to water quality and hydrology with respect to those beneficial uses.

4. Water quality objectives and standards, both numerical and narrative, for all waters of the State within the Lahontan Region, including surface waters and groundwater, are outlined in Chapter 3 of the Basin Plan. Water quality objectives and standards are intended to protect the public health and welfare, and to maintain or enhance water quality in relation to the existing and/or potential beneficial uses of the water. It is these objectives and standards that should be used when evaluating thresholds of significance for potential impacts.

5. As noted above, drainages are considered surface waters. Project-level environmental documents should provide specific information regarding impacts to surface waters, specifically the re-routing of drainages and other waters, placement and sizing of any culverts, and any mitigation that may be required for proposed impacts. The environmental document should quantify these impacts and discuss the purpose of the project, need for surface water disturbance, and propose alternatives (in order to first avoid impacts and minimize disturbances, and propose mitigation for unavoidable impacts). We request that measures be incorporated into projects to avoid surface waters and provide buffer zones where possible. If a proposed project impacts and alters drainages, then we request that the project proponent obtain permit coverage and that the project be designed such that it would maintain existing hydrologic features and patterns to the extent feasible. We encourage early consultation with the Water Board staff prior to commencement of a project.

6. The Water Board requires that impacts to water resources be avoided where feasible and minimized to the extent practical. Compensatory mitigation will be required for all unavoidable permanent impacts to surface water resources. Water Board staff coordinate all mitigation requirements with staff from other federal and state regulatory agencies, including the USACE and the California Department of Fish and Wildlife. In determining appropriate mitigation ratios for impacts to waters of the State, Water Board staff considers Basin Plan requirements (minimum 1.5:1 mitigation ratio for impacts to wetlands) and utilizes *12501-SPD Regulatory Program Standard Operating Procedure for Determination of Mitigation Ratios*, published December 2012 by the USACE, South Pacific Division.

7. Best Management Practices (BMPs) are used to reduce pollutants in runoff to waters of the State. An adequate combination of sediment and erosion control BMPs shall be implemented during active and post-construction phases of a project to manage storm water and minimize impacts from storm water runoff, such as erosion. The environmental document must specifically describe BMPs and their role in mitigation of project impacts. Keep in mind that mitigation must protect functions and values, and that measures must be identified and discussed in the environmental document. For more information, see the Basin Plan, which can be accessed via the Water Board's web site (http://www.waterboards.ca.gov/lahontan/water_issues/programs/basin_plan/references.shtml).

8. Equipment staging areas should be sited in upland areas outside stream channels and other surface waters within a project area. Buffer areas should be identified and exclusion fencing used to protect the water resource and prevent unauthorized vehicles or equipment from entering or otherwise disturbing the surface waters. Equipment should use existing roadways to the extent feasible.

Permitting Requirements for Individual Projects

A number of activities implemented by individual projects associated with the proposed Plan have the potential to impact waters of the State and, therefore, may require permits issued

by either the State Water Resources Control Board (State Water Board) or Lahontan Water Board. The required permits may include the following.

1. Streambed alteration and/or discharge of fill material to a surface water may require a CWA, section 401 water quality certification for impacts to federal waters (waters of the U.S.), or dredge and fill waste discharge requirements for impacts to non-federal waters (waters of the State only), both issued by the Lahontan Water Board or State Water Board.

2. Land disturbance of more than 1 acre may require a CWA, section 402(p) storm water permit, including a *National Pollutant Discharge Elimination System (NPDES) General Construction Storm Water Permit*, Water Quality Order (WQO) 2009-0009-DWQ, obtained from the State Water Board, or individual storm water permit obtained from the Lahontan Water Board.

3. Water diversion and/or dewatering activities may be subject to discharge and monitoring requirements under either NPDES General Permit, Limited Threat Discharges to Surface Waters, Board Order R6T-2014-0049, or General Waste Discharge Requirements for Discharges to Land with a Low Threat to Water Quality, WQO-2003-0003, both issued by the Lahontan Water Board.

Please be advised of the permits that may be required for individual projects that may be implemented under the proposed Plan, as outlined above. The specific activities that may trigger these permitting actions should be identified in the appropriate sections of the environmental document. Should Plan implementation result in activities that trigger these permitting actions, the project proponent must consult with Water Board staff. Information regarding these permits, including application forms, can be downloaded from our web site at http://www.waterboards.ca.gov/lahontan/.

Thank you for the opportunity to comment on the EA/FONSI. If you have any questions regarding this letter, please contact me at (760) 241-7333, (christina.guerra@waterboards.ca.gov) or Patrice Copeland, Supervising Engineering Geologist, at (760)241-7404 (patrice.copeland@waterboards.ca.gov).

Christina Guerra
Engineering Geologist

cc: State Clearinghouse (SCH 2017044001), stateclearinghouse@opr.ca.gov
Samuel Cox, EAFB 412 CEG/CEVA, samuel.cox.5@us.af.mil
Christopher Dirscherl, USEPA, Region IX, discherl.christopher@epa.gov
Kevin Depies, DTSC, kevin.depies@dtsc.ca.gov
Dan Waligora, CDFW, dan.waligora@wildlife.ca.gov

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LETTER FROM LAHONTAN REGIONAL WATER QUALITY CONTROL BOARD, DATED MAY 5, 2017

California Water Boards
Lahontan Regional Water Quality Control Board
2501 Lake Tahoe Boulevard
South Lake Tahoe, California 96150
Christina Guerra
Engineering Geologist

RESPONSE TO LETTER

Thank you for your response to our environmental assessment. We have reviewed and taken your inputs into consideration.

This Installation Development Plan (IDP) EA was conducted as required by the National Environmental Policy Act (NEPA), Sec. 101 [42 USC 4331] and CEQ Regulations (40 CFR Parts 1500-1508) which directs that NEPA be conducted on Federal land use plans. The IDP is a Federal plan that considers land use and therefore, NEPA must be conducted on it. Though there are actual projects noted in the IDP EA, the projects considered in this EA are not currently being actively pursued, but were developed solely as "worst case" types of projects that would be representative of the types of actions that could occur in each IDP district. As such, any future actual project, including those currently called out in the IDP EA, would require its own site-specific NEPA. In the process of conducting NEPA on a project, all water considerations, including the need for any required permits, would be taken into account.

APPENDIX B

INSTALLATION DEVELOPMENT PLAN

DOCUMENT IS NOT ATTACHED TO THE EA BECAUSE IT IS AVAILABLE FOR OFFICIAL USE ONLY (FOUO)

APPENDIX C
AIR QUALITY CALCULATIONS

Edwards AFB IDP1

Mojave Desert Air Basin, Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
General Office Building	159.00	1000sqft	3.65	159,000.00	0
Parking Lot	223.15	1000sqft	5.12	223,150.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.6	**Precipitation Freq (Days)**	31
Climate Zone	7			**Operational Year**	2018
Utility Company	Southern California Edison				
CO2 Intensity (lb/MWhr)	630.89	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use -

Construction Phase - Total construction completed per year. Coating operations estimated to occur over a 30 period spread over posssibly multiple sites.

Off-road Equipment - Compressor operating hrs reduced and architectural coating phase extended to reduce emissions.

Energy Mitigation -

Construction Off-road Equipment Mitigation - Equipment with Tier 2 engines

Table Name	Column Name	Default Value	New Value
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tblConstEquipMitigation	Tier	No Change	Tier 2
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tblConstructionPhase	NumDays	20.00	30.00
tblConstructionPhase	NumDays	230.00	170.00
tblConstructionPhase	PhaseEndDate	1/12/2018	12/29/2017
tblConstructionPhase	PhaseStartDate	12/2/2017	11/20/2017
tblOffRoadEquipment	UsageHours	6.00	4.00
tblProjectCharacteristics	OperationalYear	2014	2018
tblTripsAndVMT	HaulingTripNumber	0.00	331.00

2.0 Emissions Summary

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2017	2.4270	4.0254	4.2265	6.0200e-003	0.3085	0.2305	0.5389	0.1237	0.2153	0.3390	0.0000	518.8524	518.8524	0.0873	0.0000	520.6847
Total	**2.4270**	**4.0254**	**4.2265**	**6.0200e-003**	**0.3085**	**0.2305**	**0.5389**	**0.1237**	**0.2153**	**0.3390**	**0.0000**	**518.8524**	**518.8524**	**0.0873**	**0.0000**	**520.6847**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2017	2.4270	4.0254	4.2265	6.0200e-003	0.2187	0.2305	0.4491	0.0772	0.2153	0.2926	0.0000	518.8520	518.8520	0.0873	0.0000	520.6843
Total	**2.4270**	**4.0254**	**4.2265**	**6.0200e-003**	**0.2187**	**0.2305**	**0.4491**	**0.0772**	**0.2153**	**0.2926**	**0.0000**	**518.8520**	**518.8520**	**0.0873**	**0.0000**	**520.6843**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**29.11**	**0.00**	**16.66**	**37.55**	**0.00**	**13.70**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	1.6848	3.0000e-005	3.5600e-003	0.0000		1.0000e-005	1.0000e-005		1.0000e-005	1.0000e-005	0.0000	6.8300e-003	6.8300e-003	2.0000e-005	0.0000	7.2200e-003
Energy	0.0155	0.1405	0.1180	8.4000e-004		0.0107	0.0107		0.0107	0.0107	0.0000	715.1429	715.1429	0.0288	8.1500e-003	718.2739
Mobile	0.9910	2.7105	12.8684	0.0191	1.2054	0.0420	1.2474	0.3224	0.0386	0.3611	0.0000	1,453.0514	1,453.0514	0.0576	0.0000	1,454.2601
Waste						0.0000	0.0000		0.0000	0.0000	30.0163	0.0000	30.0163	1.7739	0.0000	67.2684
Water						0.0000	0.0000		0.0000	0.0000	8.9655	160.3677	169.3332	0.9282	0.0233	196.0388
Total	**2.6912**	**2.8511**	**12.9900**	**0.0200**	**1.2054**	**0.0526**	**1.2581**	**0.3224**	**0.0493**	**0.3717**	**38.9818**	**2,328.5688**	**2,367.5505**	**2.7885**	**0.0314**	**2,435.8485**

2.2 Overall Operational

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	1.5732	3.0000e-005	3.5600e-003	0.0000		1.0000e-005	1.0000e-005		1.0000e-005	1.0000e-005	0.0000	6.8300e-003	6.8300e-003	2.0000e-005	0.0000	7.2200e-003
Energy	0.0155	0.1405	0.1180	8.4000e-004		0.0107	0.0107		0.0107	0.0107	0.0000	715.1429	715.1429	0.0288	8.1500e-003	718.2739
Mobile	0.9714	2.5750	12.4346	0.0180	1.1276	0.0394	1.1670	0.3016	0.0362	0.3379	0.0000	1,362.7859	1,362.7859	0.0543	0.0000	1,363.9267
Waste						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Water						0.0000	0.0000		0.0000	0.0000	7.1724	135.9485	143.1209	0.7428	0.0187	164.5039
Total	**2.5601**	**2.7156**	**12.5562**	**0.0188**	**1.1276**	**0.0501**	**1.1777**	**0.3016**	**0.0469**	**0.3486**	**7.1724**	**2,213.8841**	**2,221.0565**	**0.8259**	**0.0268**	**2,246.7117**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**4.87**	**4.75**	**3.34**	**5.91**	**6.46**	**4.88**	**6.39**	**6.46**	**4.81**	**6.24**	**81.60**	**4.93**	**6.19**	**70.38**	**14.67**	**7.76**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Demolition	Demolition	1/1/2017	1/27/2017	5	20	
2	Site Preparation	Site Preparation	1/28/2017	2/10/2017	5	10	
3	Grading	Grading	2/11/2017	3/10/2017	5	20	
4	Building Construction	Building Construction	3/11/2017	11/3/2017	5	170	
5	Paving	Paving	11/4/2017	12/1/2017	5	20	
6	Architectural Coating	Architectural Coating	11/20/2017	12/29/2017	5	30	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 10

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 248,542; Non-Residential Outdoor: 82,847 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Demolition	Concrete/Industrial Saws	1	8.00	81	0.73
Demolition	Excavators	3	8.00	162	0.38
Demolition	Rubber Tired Dozers	2	8.00	255	0.40
Site Preparation	Rubber Tired Dozers	3	8.00	255	0.40
Site Preparation	Tractors/Loaders/Backhoes	4	8.00	97	0.37
Grading	Excavators	1	8.00	162	0.38
Grading	Graders	1	8.00	174	0.41
Grading	Rubber Tired Dozers	1	8.00	255	0.40
Grading	Tractors/Loaders/Backhoes	3	8.00	97	0.37
Building Construction	Cranes	1	7.00	226	0.29
Building Construction	Forklifts	3	8.00	89	0.20
Building Construction	Generator Sets	1	8.00	84	0.74
Building Construction	Tractors/Loaders/Backhoes	3	7.00	97	0.37
Building Construction	Welders	1	8.00	46	0.45
Paving	Pavers	2	8.00	125	0.42
Paving	Paving Equipment	2	8.00	130	0.36
Paving	Rollers	2	8.00	80	0.38
Architectural Coating	Air Compressors	1	4.00	78	0.48

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Demolition	6	15.00	0.00	67.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Site Preparation	7	18.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Grading	6	15.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction	9	145.00	63.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Paving	6	15.00	0.00	331.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Architectural Coating	1	29.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

Use Cleaner Engines for Construction Equipment

Water Exposed Area

Clean Paved Roads

3.2 Demolition - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					7.3800e-003	0.0000	7.3800e-003	1.1200e-003	0.0000	1.1200e-003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0405	0.4270	0.3389	4.0000e-004		0.0213	0.0213		0.0198	0.0198	0.0000	36.6182	36.6182	0.0101	0.0000	36.8292
Total	**0.0405**	**0.4270**	**0.3389**	**4.0000e-004**	**7.3800e-003**	**0.0213**	**0.0286**	**1.1200e-003**	**0.0198**	**0.0209**	**0.0000**	**36.6182**	**36.6182**	**0.0101**	**0.0000**	**36.8292**

3.2 Demolition - 2017

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	7.1000e-004	6.1200e-003	0.0102	2.0000e-005	5.8000e-004	1.6000e-004	7.4000e-004	1.6000e-004	1.5000e-004	3.1000e-004	0.0000	2.1457	2.1457	1.0000e-005	0.0000	2.1459
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	5.2000e-004	8.8000e-004	8.2800e-003	1.0000e-005	1.2100e-003	1.0000e-005	1.2200e-003	3.2000e-004	1.0000e-005	3.3000e-004	0.0000	1.0332	1.0332	6.0000e-005	0.0000	1.0346
Total	**1.2300e-003**	**7.0000e-003**	**0.0185**	**3.0000e-005**	**1.7900e-003**	**1.7000e-004**	**1.9600e-003**	**4.8000e-004**	**1.6000e-004**	**6.4000e-004**	**0.0000**	**3.1788**	**3.1788**	**7.0000e-005**	**0.0000**	**3.1805**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					3.3200e-003	0.0000	3.3200e-003	5.0000e-004	0.0000	5.0000e-004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0405	0.4270	0.3389	4.0000e-004		0.0213	0.0213		0.0198	0.0198	0.0000	36.6182	36.6182	0.0101	0.0000	36.8291
Total	**0.0405**	**0.4270**	**0.3389**	**4.0000e-004**	**3.3200e-003**	**0.0213**	**0.0246**	**5.0000e-004**	**0.0198**	**0.0203**	**0.0000**	**36.6182**	**36.6182**	**0.0101**	**0.0000**	**36.8291**

3.2 Demolition - 2017

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	7.1000e-004	6.1200e-003	0.0102	2.0000e-005	5.8000e-004	1.6000e-004	7.4000e-004	1.6000e-004	1.5000e-004	3.1000e-004	0.0000	2.1457	2.1457	1.0000e-005	0.0000	2.1459
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	5.2000e-004	8.8000e-004	8.2800e-003	1.0000e-005	1.2100e-003	1.0000e-005	1.2200e-003	3.2000e-004	1.0000e-005	3.3000e-004	0.0000	1.0332	1.0332	6.0000e-005	0.0000	1.0346
Total	**1.2300e-003**	**7.0000e-003**	**0.0185**	**3.0000e-005**	**1.7900e-003**	**1.7000e-004**	**1.9600e-003**	**4.8000e-004**	**1.6000e-004**	**6.4000e-004**	**0.0000**	**3.1788**	**3.1788**	**7.0000e-005**	**0.0000**	**3.1805**

3.3 Site Preparation - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.0903	0.0000	0.0903	0.0497	0.0000	0.0497	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0242	0.2588	0.1970	2.0000e-004		0.0138	0.0138		0.0127	0.0127	0.0000	18.1577	18.1577	5.5600e-003	0.0000	18.2745
Total	**0.0242**	**0.2588**	**0.1970**	**2.0000e-004**	**0.0903**	**0.0138**	**0.1041**	**0.0497**	**0.0127**	**0.0623**	**0.0000**	**18.1577**	**18.1577**	**5.5600e-003**	**0.0000**	**18.2745**

3.3 Site Preparation - 2017

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	3.1000e-004	5.3000e-004	4.9700e-003	1.0000e-005	7.3000e-004	1.0000e-005	7.3000e-004	1.9000e-004	0.0000	2.0000e-004	0.0000	0.6199	0.6199	4.0000e-005	0.0000	0.6207
Total	**3.1000e-004**	**5.3000e-004**	**4.9700e-003**	**1.0000e-005**	**7.3000e-004**	**1.0000e-005**	**7.3000e-004**	**1.9000e-004**	**0.0000**	**2.0000e-004**	**0.0000**	**0.6199**	**0.6199**	**4.0000e-005**	**0.0000**	**0.6207**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.0407	0.0000	0.0407	0.0223	0.0000	0.0223	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0242	0.2588	0.1970	2.0000e-004		0.0138	0.0138		0.0127	0.0127	0.0000	18.1577	18.1577	5.5600e-003	0.0000	18.2745
Total	**0.0242**	**0.2588**	**0.1970**	**2.0000e-004**	**0.0407**	**0.0138**	**0.0544**	**0.0223**	**0.0127**	**0.0350**	**0.0000**	**18.1577**	**18.1577**	**5.5600e-003**	**0.0000**	**18.2745**

3.3 Site Preparation - 2017

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	3.1000e-004	5.3000e-004	4.9700e-003	1.0000e-005	7.3000e-004	1.0000e-005	7.3000e-004	1.9000e-004	0.0000	2.0000e-004	0.0000	0.6199	0.6199	4.0000e-005	0.0000	0.6207
Total	**3.1000e-004**	**5.3000e-004**	**4.9700e-003**	**1.0000e-005**	**7.3000e-004**	**1.0000e-005**	**7.3000e-004**	**1.9000e-004**	**0.0000**	**2.0000e-004**	**0.0000**	**0.6199**	**0.6199**	**4.0000e-005**	**0.0000**	**0.6207**

3.4 Grading - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.0655	0.0000	0.0655	0.0337	0.0000	0.0337	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0346	0.3598	0.2538	3.0000e-004		0.0204	0.0204		0.0188	0.0188	0.0000	27.6117	27.6117	8.4600e-003	0.0000	27.7893
Total	**0.0346**	**0.3598**	**0.2538**	**3.0000e-004**	**0.0655**	**0.0204**	**0.0859**	**0.0337**	**0.0188**	**0.0524**	**0.0000**	**27.6117**	**27.6117**	**8.4600e-003**	**0.0000**	**27.7893**

3.4 Grading - 2017

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	5.2000e-004	8.8000e-004	8.2800e-003	1.0000e-005	1.2100e-003	1.0000e-005	1.2200e-003	3.2000e-004	1.0000e-005	3.3000e-004	0.0000	1.0332	1.0332	6.0000e-005	0.0000	1.0346
Total	**5.2000e-004**	**8.8000e-004**	**8.2800e-003**	**1.0000e-005**	**1.2100e-003**	**1.0000e-005**	**1.2200e-003**	**3.2000e-004**	**1.0000e-005**	**3.3000e-004**	**0.0000**	**1.0332**	**1.0332**	**6.0000e-005**	**0.0000**	**1.0346**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.0295	0.0000	0.0295	0.0152	0.0000	0.0152	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0346	0.3598	0.2538	3.0000e-004		0.0204	0.0204		0.0188	0.0188	0.0000	27.6117	27.6117	8.4600e-003	0.0000	27.7893
Total	**0.0346**	**0.3598**	**0.2538**	**3.0000e-004**	**0.0295**	**0.0204**	**0.0499**	**0.0152**	**0.0188**	**0.0339**	**0.0000**	**27.6117**	**27.6117**	**8.4600e-003**	**0.0000**	**27.7893**

3.4 Grading - 2017

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	5.2000e-004	8.8000e-004	8.2800e-003	1.0000e-005	1.2100e-003	1.0000e-005	1.2200e-003	3.2000e-004	1.0000e-005	3.3000e-004	0.0000	1.0332	1.0332	6.0000e-005	0.0000	1.0346
Total	**5.2000e-004**	**8.8000e-004**	**8.2800e-003**	**1.0000e-005**	**1.2100e-003**	**1.0000e-005**	**1.2200e-003**	**3.2000e-004**	**1.0000e-005**	**3.3000e-004**	**0.0000**	**1.0332**	**1.0332**	**6.0000e-005**	**0.0000**	**1.0346**

3.5 Building Construction - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.2637	2.2445	1.5410	2.2800e-003		0.1514	0.1514		0.1422	0.1422	0.0000	203.5572	203.5572	0.0501	0.0000	204.6093
Total	**0.2637**	**2.2445**	**1.5410**	**2.2800e-003**		**0.1514**	**0.1514**		**0.1422**	**0.1422**	**0.0000**	**203.5572**	**203.5572**	**0.0501**	**0.0000**	**204.6093**

3.5 Building Construction - 2017

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0650	0.3960	0.9347	1.1800e-003	0.0345	8.7700e-003	0.0433	9.8100e-003	8.0600e-003	0.0179	0.0000	105.3054	105.3054	6.5000e-004	0.0000	105.3190
Worker	0.0424	0.0726	0.6805	1.1800e-003	0.0994	7.3000e-004	0.1001	0.0264	6.7000e-004	0.0271	0.0000	84.8940	84.8940	5.3300e-003	0.0000	85.0060
Total	**0.1074**	**0.4685**	**1.6151**	**2.3600e-003**	**0.1339**	**9.5000e-003**	**0.1434**	**0.0362**	**8.7300e-003**	**0.0449**	**0.0000**	**190.1994**	**190.1994**	**5.9800e-003**	**0.0000**	**190.3250**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.2637	2.2445	1.5410	2.2800e-003		0.1514	0.1514		0.1422	0.1422	0.0000	203.5570	203.5570	0.0501	0.0000	204.6091
Total	**0.2637**	**2.2445**	**1.5410**	**2.2800e-003**		**0.1514**	**0.1514**		**0.1422**	**0.1422**	**0.0000**	**203.5570**	**203.5570**	**0.0501**	**0.0000**	**204.6091**

3.5 Building Construction - 2017

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0650	0.3960	0.9347	1.1800e-003	0.0345	8.7700e-003	0.0433	9.8100e-003	8.0600e-003	0.0179	0.0000	105.3054	105.3054	6.5000e-004	0.0000	105.3190
Worker	0.0424	0.0726	0.6805	1.1800e-003	0.0994	7.3000e-004	0.1001	0.0264	6.7000e-004	0.0271	0.0000	84.8940	84.8940	5.3300e-003	0.0000	85.0060
Total	**0.1074**	**0.4685**	**1.6151**	**2.3600e-003**	**0.1339**	**9.5000e-003**	**0.1434**	**0.0362**	**8.7300e-003**	**0.0449**	**0.0000**	**190.1994**	**190.1994**	**5.9800e-003**	**0.0000**	**190.3250**

3.6 Paving - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0191	0.2030	0.1473	2.2000e-004		0.0114	0.0114		0.0105	0.0105	0.0000	20.6934	20.6934	6.3400e-003	0.0000	20.8266
Paving	6.7100e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0258**	**0.2030**	**0.1473**	**2.2000e-004**		**0.0114**	**0.0114**		**0.0105**	**0.0105**	**0.0000**	**20.6934**	**20.6934**	**6.3400e-003**	**0.0000**	**20.8266**

3.6 Paving - 2017

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	3.5300e-003	0.0302	0.0506	1.2000e-004	2.8500e-003	8.2000e-004	3.6700e-003	7.8000e-004	7.5000e-004	1.5300e-003	0.0000	10.6001	10.6001	6.0000e-005	0.0000	10.6014
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	5.2000e-004	8.8000e-004	8.2800e-003	1.0000e-005	1.2100e-003	1.0000e-005	1.2200e-003	3.2000e-004	1.0000e-005	3.3000e-004	0.0000	1.0332	1.0332	6.0000e-005	0.0000	1.0346
Total	**4.0500e-003**	**0.0311**	**0.0589**	**1.3000e-004**	**4.0600e-003**	**8.3000e-004**	**4.8900e-003**	**1.1000e-003**	**7.6000e-004**	**1.8600e-003**	**0.0000**	**11.6333**	**11.6333**	**1.2000e-004**	**0.0000**	**11.6359**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0191	0.2030	0.1473	2.2000e-004		0.0114	0.0114		0.0105	0.0105	0.0000	20.6934	20.6934	6.3400e-003	0.0000	20.8265
Paving	6.7100e-003					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0258**	**0.2030**	**0.1473**	**2.2000e-004**		**0.0114**	**0.0114**		**0.0105**	**0.0105**	**0.0000**	**20.6934**	**20.6934**	**6.3400e-003**	**0.0000**	**20.8265**

3.6 Paving - 2017

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	3.5300e-003	0.0302	0.0506	1.2000e-004	2.8500e-003	8.2000e-004	3.6700e-003	7.8000e-004	7.5000e-004	1.5300e-003	0.0000	10.6001	10.6001	6.0000e-005	0.0000	10.6014
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	5.2000e-004	8.8000e-004	8.2800e-003	1.0000e-005	1.2100e-003	1.0000e-005	1.2200e-003	3.2000e-004	1.0000e-005	3.3000e-004	0.0000	1.0332	1.0332	6.0000e-005	0.0000	1.0346
Total	**4.0500e-003**	**0.0311**	**0.0589**	**1.3000e-004**	**4.0600e-003**	**8.3000e-004**	**4.8900e-003**	**1.1000e-003**	**7.6000e-004**	**1.8600e-003**	**0.0000**	**11.6333**	**11.6333**	**1.2000e-004**	**0.0000**	**11.6359**

3.7 Architectural Coating - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Archit. Coating	1.9200					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	3.3200e-003	0.0219	0.0187	3.0000e-005		1.7300e-003	1.7300e-003		1.7300e-003	1.7300e-003	0.0000	2.5533	2.5533	2.7000e-004	0.0000	2.5589
Total	**1.9233**	**0.0219**	**0.0187**	**3.0000e-005**		**1.7300e-003**	**1.7300e-003**		**1.7300e-003**	**1.7300e-003**	**0.0000**	**2.5533**	**2.5533**	**2.7000e-004**	**0.0000**	**2.5589**

3.7 Architectural Coating - 2017

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	1.5000e-003	2.5600e-003	0.0240	4.0000e-005	3.5100e-003	3.0000e-005	3.5300e-003	9.3000e-004	2.0000e-005	9.6000e-004	0.0000	2.9963	2.9963	1.9000e-004	0.0000	3.0002
Total	**1.5000e-003**	**2.5600e-003**	**0.0240**	**4.0000e-005**	**3.5100e-003**	**3.0000e-005**	**3.5300e-003**	**9.3000e-004**	**2.0000e-005**	**9.6000e-004**	**0.0000**	**2.9963**	**2.9963**	**1.9000e-004**	**0.0000**	**3.0002**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Archit. Coating	1.9200					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	3.3200e-003	0.0219	0.0187	3.0000e-005		1.7300e-003	1.7300e-003		1.7300e-003	1.7300e-003	0.0000	2.5533	2.5533	2.7000e-004	0.0000	2.5589
Total	**1.9233**	**0.0219**	**0.0187**	**3.0000e-005**		**1.7300e-003**	**1.7300e-003**		**1.7300e-003**	**1.7300e-003**	**0.0000**	**2.5533**	**2.5533**	**2.7000e-004**	**0.0000**	**2.5589**

3.7 Architectural Coating - 2017

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	1.5000e-003	2.5600e-003	0.0240	4.0000e-005	3.5100e-003	3.0000e-005	3.5300e-003	9.3000e-004	2.0000e-005	9.6000e-004	0.0000	2.9963	2.9963	1.9000e-004	0.0000	3.0002
Total	**1.5000e-003**	**2.5600e-003**	**0.0240**	**4.0000e-005**	**3.5100e-003**	**3.0000e-005**	**3.5300e-003**	**9.3000e-004**	**2.0000e-005**	**9.6000e-004**	**0.0000**	**2.9963**	**2.9963**	**1.9000e-004**	**0.0000**	**3.0002**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

Improve Pedestrian Network

Encourage Telecommuting and Alternative Work Schedules

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	0.9714	2.5750	12.4346	0.0180	1.1276	0.0394	1.1670	0.3016	0.0362	0.3379	0.0000	1,362.7859	1,362.7859	0.0543	0.0000	1,363.9267
Unmitigated	0.9910	2.7105	12.8684	0.0191	1.2054	0.0420	1.2474	0.3224	0.0386	0.3611	0.0000	1,453.0514	1,453.0514	0.0576	0.0000	1,454.2601

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
General Office Building	1,750.59	376.83	155.82	3,170,041	2,965,305
Parking Lot	0.00	0.00	0.00		
Total	1,750.59	376.83	155.82	3,170,041	2,965,305

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
General Office Building	9.50	7.30	7.30	33.00	48.00	19.00	77	19	4
Parking Lot	9.50	7.30	7.30	0.00	0.00	0.00	0	0	0

LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
0.433084	0.067774	0.178855	0.157581	0.054931	0.008753	0.007036	0.074865	0.001146	0.001007	0.009750	0.000669	0.004549

4.4 Fleet Mix

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Electricity Mitigated						0.0000	0.0000		0.0000	0.0000	0.0000	562.1611	562.1611	0.0258	5.3500e-003	564.3612
Electricity Unmitigated						0.0000	0.0000		0.0000	0.0000	0.0000	562.1611	562.1611	0.0258	5.3500e-003	564.3612
NaturalGas Mitigated	0.0155	0.1405	0.1180	8.4000e-004		0.0107	0.0107		0.0107	0.0107	0.0000	152.9818	152.9818	2.9300e-003	2.8000e-003	153.9128
NaturalGas Unmitigated	0.0155	0.1405	0.1180	8.4000e-004		0.0107	0.0107		0.0107	0.0107	0.0000	152.9818	152.9818	2.9300e-003	2.8000e-003	153.9128

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
General Office Building	2.86677e+006	0.0155	0.1405	0.1180	8.4000e-004		0.0107	0.0107		0.0107	0.0107	0.0000	152.9818	152.9818	2.9300e-003	2.8000e-003	153.9128
Parking Lot	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0155**	**0.1405**	**0.1180**	**8.4000e-004**		**0.0107**	**0.0107**		**0.0107**	**0.0107**	**0.0000**	**152.9818**	**152.9818**	**2.9300e-003**	**2.8000e-003**	**153.9128**

5.2 Energy by Land Use - NaturalGas

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
General Office Building	2.86677e+006	0.0155	0.1405	0.1180	8.4000e-004		0.0107	0.0107		0.0107	0.0107	0.0000	152.9818	152.9818	2.9300e-003	2.8000e-003	153.9128
Parking Lot	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0155**	**0.1405**	**0.1180**	**8.4000e-004**		**0.0107**	**0.0107**		**0.0107**	**0.0107**	**0.0000**	**152.9818**	**152.9818**	**2.9300e-003**	**2.8000e-003**	**153.9128**

5.3 Energy by Land Use - Electricity

Unmitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
General Office Building	1.76808e+006	505.9660	0.0233	4.8100e-003	507.9461
Parking Lot	196372	56.1952	2.5800e-003	5.3000e-004	56.4151
Total		**562.1611**	**0.0258**	**5.3400e-003**	**564.3612**

5.3 Energy by Land Use - Electricity

Mitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
Parking Lot	196372	56.1952	2.5800e-003	5.3000e-004	56.4151
General Office Building	1.76808e+006	505.9660	0.0233	4.8100e-003	507.9461
Total		**562.1611**	**0.0258**	**5.3400e-003**	**564.3612**

6.0 Area Detail

6.1 Mitigation Measures Area

Use Low VOC Paint - Non-Residential Interior

Use Low VOC Paint - Non-Residential Exterior

Use Low VOC Cleaning Supplies

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	1.5732	3.0000e-005	3.5600e-003	0.0000		1.0000e-005	1.0000e-005		1.0000e-005	1.0000e-005	0.0000	6.8300e-003	6.8300e-003	2.0000e-005	0.0000	7.2200e-003
Unmitigated	1.6848	3.0000e-005	3.5600e-003	0.0000		1.0000e-005	1.0000e-005		1.0000e-005	1.0000e-005	0.0000	6.8300e-003	6.8300e-003	2.0000e-005	0.0000	7.2200e-003

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	0.1920					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	1.4925					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	3.4000e-004	3.0000e-005	3.5600e-003	0.0000		1.0000e-005	1.0000e-005		1.0000e-005	1.0000e-005	0.0000	6.8300e-003	6.8300e-003	2.0000e-005	0.0000	7.2200e-003
Total	**1.6848**	**3.0000e-005**	**3.5600e-003**	**0.0000**		**1.0000e-005**	**1.0000e-005**		**1.0000e-005**	**1.0000e-005**	**0.0000**	**6.8300e-003**	**6.8300e-003**	**2.0000e-005**	**0.0000**	**7.2200e-003**

6.2 Area by SubCategory

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	0.1920					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	1.3809					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	3.4000e-004	3.0000e-005	3.5600e-003	0.0000		1.0000e-005	1.0000e-005		1.0000e-005	1.0000e-005	0.0000	6.8300e-003	6.8300e-003	2.0000e-005	0.0000	7.2200e-003
Total	**1.5732**	**3.0000e-005**	**3.5600e-003**	**0.0000**		**1.0000e-005**	**1.0000e-005**		**1.0000e-005**	**1.0000e-005**	**0.0000**	**6.8300e-003**	**6.8300e-003**	**2.0000e-005**	**0.0000**	**7.2200e-003**

7.0 Water Detail

7.1 Mitigation Measures Water

Install Low Flow Bathroom Faucet

Install Low Flow Kitchen Faucet

Install Low Flow Toilet

Install Low Flow Shower

Use Water Efficient Irrigation System

Use Water Efficient Landscaping

	Total CO2	CH4	N2O	CO2e
Category	MT/yr			
Mitigated	143.1209	0.7428	0.0187	164.5039
Unmitigated	169.3332	0.9282	0.0233	196.0388

7.2 Water by Land Use

Unmitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
General Office Building	28.2597 / 17.3204	169.3332	0.9282	0.0233	196.0388
Parking Lot	0 / 0	0.0000	0.0000	0.0000	0.0000
Total		**169.3332**	**0.9282**	**0.0233**	**196.0388**

7.2 Water by Land Use

Mitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
General Office Building	22.6077 / 16.2639	143.1209	0.7428	0.0187	164.5039
Parking Lot	0 / 0	0.0000	0.0000	0.0000	0.0000
Total		**143.1209**	**0.7428**	**0.0187**	**164.5039**

8.0 Waste Detail

8.1 Mitigation Measures Waste

Institute Recycling and Composting Services

Category/Year

	Total CO2	CH4	N2O	CO2e
	MT/yr			
Mitigated	0.0000	0.0000	0.0000	0.0000
Unmitigated	30.0163	1.7739	0.0000	67.2684

8.2 Waste by Land Use

Unmitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
General Office Building	147.87	30.0163	1.7739	0.0000	67.2684
Parking Lot	0	0.0000	0.0000	0.0000	0.0000
Total		**30.0163**	**1.7739**	**0.0000**	**67.2684**

Mitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
General Office Building		0.0000	0.0000	0.0000	0.0000
Parking Lot		0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Vegetation

Edwards AFB IDP1

Mojave Desert Air Basin, Summer

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
General Office Building	159.00	1000sqft	3.65	159,000.00	0
Parking Lot	223.15	1000sqft	5.12	223,150.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.6	**Precipitation Freq (Days)**	31
Climate Zone	7			**Operational Year**	2018
Utility Company	Southern California Edison				
CO2 Intensity (lb/MWhr)	630.89	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use -

Construction Phase - Total construction completed per year. Coating operations estimated to occur over a 30 period spread over posssibly multiple sites.

Off-road Equipment - Compressor operating hrs reduced and architectural coating phase extended to reduce emissions.

Energy Mitigation -

Construction Off-road Equipment Mitigation - Equipment with Tier 2 engines

Table Name	Column Name	Default Value	New Value
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 3
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstructionPhase	NumDays	20.00	30.00
tblConstructionPhase	NumDays	230.00	170.00
tblConstructionPhase	PhaseEndDate	1/12/2018	12/29/2017
tblConstructionPhase	PhaseStartDate	12/2/2017	11/20/2017
tblOffRoadEquipment	UsageHours	6.00	4.00
tblProjectCharacteristics	OperationalYear	2014	2018
tblTripsAndVMT	HaulingTripNumber	0.00	331.00

2.0 Emissions Summary

2.1 Overall Construction (Maximum Daily Emission)

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2017	131.2942	51.8486	40.5306	0.0560	18.2141	2.7553	20.9694	9.9699	2.5349	12.5048	0.0000	5,219.3301	5,219.3301	1.2351	0.0000	5,245.2677
Total	**131.2942**	**51.8486**	**40.5306**	**0.0560**	**18.2141**	**2.7553**	**20.9694**	**9.9699**	**2.5349**	**12.5048**	**0.0000**	**5,219.3301**	**5,219.3301**	**1.2351**	**0.0000**	**5,245.2677**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2017	131.2942	51.8486	40.5306	0.0560	8.2777	2.7553	11.0330	4.5080	2.5349	7.0429	0.0000	5,219.3301	5,219.3301	1.2351	0.0000	5,245.2677
Total	**131.2942**	**51.8486**	**40.5306**	**0.0560**	**8.2777**	**2.7553**	**11.0330**	**4.5080**	**2.5349**	**7.0429**	**0.0000**	**5,219.3301**	**5,219.3301**	**1.2351**	**0.0000**	**5,245.2677**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**54.55**	**0.00**	**47.39**	**54.78**	**0.00**	**43.68**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	9.2338	3.7000e-004	0.0396	0.0000		1.4000e-004	1.4000e-004		1.4000e-004	1.4000e-004		0.0836	0.0836	2.3000e-004		0.0885
Energy	0.0847	0.7700	0.6468	4.6200e-003		0.0585	0.0585		0.0585	0.0585		924.0193	924.0193	0.0177	0.0169	929.6428
Mobile	7.6697	18.3248	89.5731	0.1481	8.9020	0.3040	9.2060	2.3777	0.2798	2.6574		12,343.4364	12,343.4364	0.4602		12,353.1001
Total	**16.9882**	**19.0952**	**90.2595**	**0.1527**	**8.9020**	**0.3627**	**9.2647**	**2.3777**	**0.3384**	**2.7161**		**13,267.5394**	**13,267.5394**	**0.4781**	**0.0169**	**13,282.8313**

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	8.6224	3.7000e-004	0.0396	0.0000		1.4000e-004	1.4000e-004		1.4000e-004	1.4000e-004		0.0836	0.0836	2.3000e-004		0.0885
Energy	0.0847	0.7700	0.6468	4.6200e-003		0.0585	0.0585		0.0585	0.0585		924.0193	924.0193	0.0177	0.0169	929.6428
Mobile	7.5209	17.4181	85.8941	0.1389	8.3271	0.2854	8.6125	2.2241	0.2626	2.4867		11,575.5684	11,575.5684	0.4343		11,584.6881
Total	**16.2280**	**18.1885**	**86.5805**	**0.1435**	**8.3271**	**0.3440**	**8.6711**	**2.2241**	**0.3213**	**2.5454**		**12,499.6714**	**12,499.6714**	**0.4522**	**0.0169**	**12,514.4193**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	4.47	4.75	4.08	6.02	6.46	5.14	6.41	6.46	5.07	6.29	0.00	5.79	5.79	5.42	0.00	5.79

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Demolition	Demolition	1/1/2017	1/27/2017	5	20	
2	Site Preparation	Site Preparation	1/28/2017	2/10/2017	5	10	
3	Grading	Grading	2/11/2017	3/10/2017	5	20	
4	Building Construction	Building Construction	3/11/2017	11/3/2017	5	170	
5	Paving	Paving	11/4/2017	12/1/2017	5	20	
6	Architectural Coating	Architectural Coating	11/20/2017	12/29/2017	5	30	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 10

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 248,542; Non-Residential Outdoor: 82,847 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Demolition	Concrete/Industrial Saws	1	8.00	81	0.73
Demolition	Excavators	3	8.00	162	0.38
Demolition	Rubber Tired Dozers	2	8.00	255	0.40
Site Preparation	Rubber Tired Dozers	3	8.00	255	0.40
Site Preparation	Tractors/Loaders/Backhoes	4	8.00	97	0.37
Grading	Excavators	1	8.00	162	0.38
Grading	Graders	1	8.00	174	0.41
Grading	Rubber Tired Dozers	1	8.00	255	0.40
Grading	Tractors/Loaders/Backhoes	3	8.00	97	0.37
Building Construction	Cranes	1	7.00	226	0.29
Building Construction	Forklifts	3	8.00	89	0.20
Building Construction	Generator Sets	1	8.00	84	0.74
Building Construction	Tractors/Loaders/Backhoes	3	7.00	97	0.37
Building Construction	Welders	1	8.00	46	0.45
Paving	Pavers	2	8.00	125	0.42
Paving	Paving Equipment	2	8.00	130	0.36
Paving	Rollers	2	8.00	80	0.38
Architectural Coating	Air Compressors	1	4.00	78	0.48

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Demolition	6	15.00	0.00	67.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Site Preparation	7	18.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Grading	6	15.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction	9	145.00	63.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Paving	6	15.00	0.00	331.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Architectural Coating	1	29.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

Use Cleaner Engines for Construction Equipment

Water Exposed Area

Clean Paved Roads

3.2 Demolition - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					0.7375	0.0000	0.7375	0.1117	0.0000	0.1117			0.0000			0.0000
Off-Road	4.0482	42.6971	33.8934	0.0399		2.1252	2.1252		1.9797	1.9797		4,036.467 4	4,036.467 4	1.1073		4,059.721 1
Total	**4.0482**	**42.6971**	**33.8934**	**0.0399**	**0.7375**	**2.1252**	**2.8627**	**0.1117**	**1.9797**	**2.0914**		**4,036.467 4**	**4,036.467 4**	**1.1073**		**4,059.721 1**

3.2 Demolition - 2017

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0645	0.5772	0.8128	2.3900e-003	0.0587	0.0165	0.0752	0.0161	0.0152	0.0313		236.7617	236.7617	1.3000e-003		236.7891
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0603	0.0793	0.9447	1.5800e-003	0.1232	8.9000e-004	0.1241	0.0327	8.2000e-004	0.0335		125.0813	125.0813	7.1500e-003		125.2315
Total	**0.1248**	**0.6565**	**1.7575**	**3.9700e-003**	**0.1819**	**0.0174**	**0.1993**	**0.0488**	**0.0160**	**0.0648**		**361.8430**	**361.8430**	**8.4500e-003**		**362.0206**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					0.3319	0.0000	0.3319	0.0503	0.0000	0.0503			0.0000			0.0000
Off-Road	4.0482	42.6971	33.8934	0.0399		2.1252	2.1252		1.9797	1.9797	0.0000	4,036.4674	4,036.4674	1.1073		4,059.7211
Total	**4.0482**	**42.6971**	**33.8934**	**0.0399**	**0.3319**	**2.1252**	**2.4571**	**0.0503**	**1.9797**	**2.0300**	**0.0000**	**4,036.4674**	**4,036.4674**	**1.1073**		**4,059.7211**

3.2 Demolition - 2017

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0645	0.5772	0.8128	2.3900e-003	0.0587	0.0165	0.0752	0.0161	0.0152	0.0313		236.7617	236.7617	1.3000e-003		236.7891
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0603	0.0793	0.9447	1.5800e-003	0.1232	8.9000e-004	0.1241	0.0327	8.2000e-004	0.0335		125.0813	125.0813	7.1500e-003		125.2315
Total	**0.1248**	**0.6565**	**1.7575**	**3.9700e-003**	**0.1819**	**0.0174**	**0.1993**	**0.0488**	**0.0160**	**0.0648**		**361.8430**	**361.8430**	**8.4500e-003**		**362.0206**

3.3 Site Preparation - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					18.0663	0.0000	18.0663	9.9307	0.0000	9.9307			0.0000			0.0000
Off-Road	4.8382	51.7535	39.3970	0.0391		2.7542	2.7542		2.5339	2.5339		4,003.0859	4,003.0859	1.2265		4,028.8432
Total	**4.8382**	**51.7535**	**39.3970**	**0.0391**	**18.0663**	**2.7542**	**20.8205**	**9.9307**	**2.5339**	**12.4646**		**4,003.0859**	**4,003.0859**	**1.2265**		**4,028.8432**

3.3 Site Preparation - 2017

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0724	0.0951	1.1336	1.8900e-003	0.1479	1.0700e-003	0.1489	0.0392	9.8000e-004	0.0402		150.0975	150.0975	8.5900e-003		150.2778
Total	**0.0724**	**0.0951**	**1.1336**	**1.8900e-003**	**0.1479**	**1.0700e-003**	**0.1489**	**0.0392**	**9.8000e-004**	**0.0402**		**150.0975**	**150.0975**	**8.5900e-003**		**150.2778**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					8.1298	0.0000	8.1298	4.4688	0.0000	4.4688			0.0000			0.0000
Off-Road	4.8382	51.7535	39.3970	0.0391		2.7542	2.7542		2.5339	2.5339	0.0000	4,003.0859	4,003.0859	1.2265		4,028.8432
Total	**4.8382**	**51.7535**	**39.3970**	**0.0391**	**8.1298**	**2.7542**	**10.8840**	**4.4688**	**2.5339**	**7.0027**	**0.0000**	**4,003.0859**	**4,003.0859**	**1.2265**		**4,028.8432**

3.3 Site Preparation - 2017

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0724	0.0951	1.1336	1.8900e-003	0.1479	1.0700e-003	0.1489	0.0392	9.8000e-004	0.0402		150.0975	150.0975	8.5900e-003		150.2778
Total	**0.0724**	**0.0951**	**1.1336**	**1.8900e-003**	**0.1479**	**1.0700e-003**	**0.1489**	**0.0392**	**9.8000e-004**	**0.0402**		**150.0975**	**150.0975**	**8.5900e-003**		**150.2778**

3.4 Grading - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					6.5523	0.0000	6.5523	3.3675	0.0000	3.3675			0.0000			0.0000
Off-Road	3.4555	35.9825	25.3812	0.0297		2.0388	2.0388		1.8757	1.8757		3,043.666 7	3,043.666 7	0.9326		3,063.250 7
Total	**3.4555**	**35.9825**	**25.3812**	**0.0297**	**6.5523**	**2.0388**	**8.5912**	**3.3675**	**1.8757**	**5.2432**		**3,043.666 7**	**3,043.666 7**	**0.9326**		**3,063.250 7**

3.4 Grading - 2017

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0603	0.0793	0.9447	1.5800e-003	0.1232	8.9000e-004	0.1241	0.0327	8.2000e-004	0.0335		125.0813	125.0813	7.1500e-003		125.2315
Total	**0.0603**	**0.0793**	**0.9447**	**1.5800e-003**	**0.1232**	**8.9000e-004**	**0.1241**	**0.0327**	**8.2000e-004**	**0.0335**		**125.0813**	**125.0813**	**7.1500e-003**		**125.2315**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					2.9486	0.0000	2.9486	1.5154	0.0000	1.5154			0.0000			0.0000
Off-Road	3.4555	35.9825	25.3812	0.0297		2.0388	2.0388		1.8757	1.8757	0.0000	3,043.6667	3,043.6667	0.9326		3,063.2507
Total	**3.4555**	**35.9825**	**25.3812**	**0.0297**	**2.9486**	**2.0388**	**4.9874**	**1.5154**	**1.8757**	**3.3911**	**0.0000**	**3,043.6667**	**3,043.6667**	**0.9326**		**3,063.2507**

3.4 Grading - 2017

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0603	0.0793	0.9447	1.5800e-003	0.1232	8.9000e-004	0.1241	0.0327	8.2000e-004	0.0335		125.0813	125.0813	7.1500e-003		125.2315
Total	**0.0603**	**0.0793**	**0.9447**	**1.5800e-003**	**0.1232**	**8.9000e-004**	**0.1241**	**0.0327**	**8.2000e-004**	**0.0335**		**125.0813**	**125.0813**	**7.1500e-003**		**125.2315**

3.5 Building Construction - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	3.1024	26.4057	18.1291	0.0268		1.7812	1.7812		1.6730	1.6730		2,639.8053	2,639.8053	0.6497		2,653.4490
Total	**3.1024**	**26.4057**	**18.1291**	**0.0268**		**1.7812**	**1.7812**		**1.6730**	**1.6730**		**2,639.8053**	**2,639.8053**	**0.6497**		**2,653.4490**

3.5 Building Construction - 2017

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.6836	4.4251	8.5339	0.0139	0.4129	0.1028	0.5157	0.1170	0.0945	0.2115		1,370.405 9	1,370.405 9	8.2600e-003		1,370.579 4
Worker	0.5828	0.7663	9.1316	0.0153	1.1911	8.6300e-003	1.1998	0.3160	7.9300e-003	0.3239		1,209.118 9	1,209.118 9	0.0692		1,210.571 2
Total	**1.2664**	**5.1915**	**17.6655**	**0.0292**	**1.6040**	**0.1114**	**1.7154**	**0.4329**	**0.1025**	**0.5354**		**2,579.524 8**	**2,579.524 8**	**0.0774**		**2,581.150 6**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	3.1024	26.4057	18.1291	0.0268		1.7812	1.7812		1.6730	1.6730	0.0000	2,639.805 3	2,639.805 3	0.6497		2,653.449 0
Total	**3.1024**	**26.4057**	**18.1291**	**0.0268**		**1.7812**	**1.7812**		**1.6730**	**1.6730**	**0.0000**	**2,639.805 3**	**2,639.805 3**	**0.6497**		**2,653.449 0**

3.5 Building Construction - 2017

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.6836	4.4251	8.5339	0.0139	0.4129	0.1028	0.5157	0.1170	0.0945	0.2115		1,370.405 9	1,370.405 9	8.2600e-003		1,370.579 4
Worker	0.5828	0.7663	9.1316	0.0153	1.1911	8.6300e-003	1.1998	0.3160	7.9300e-003	0.3239		1,209.118 9	1,209.118 9	0.0692		1,210.571 2
Total	**1.2664**	**5.1915**	**17.6655**	**0.0292**	**1.6040**	**0.1114**	**1.7154**	**0.4329**	**0.1025**	**0.5354**		**2,579.524 8**	**2,579.524 8**	**0.0774**		**2,581.150 6**

3.6 Paving - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	1.9074	20.2964	14.7270	0.0223		1.1384	1.1384		1.0473	1.0473		2,281.058 8	2,281.058 8	0.6989		2,295.736 0
Paving	0.6707					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Total	**2.5781**	**20.2964**	**14.7270**	**0.0223**		**1.1384**	**1.1384**		**1.0473**	**1.0473**		**2,281.058 8**	**2,281.058 8**	**0.6989**		**2,295.736 0**

3.6 Paving - 2017

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.3187	2.8517	4.0156	0.0118	0.2901	0.0815	0.3715	0.0796	0.0749	0.1545		1,169.6736	1,169.6736	6.4300e-003		1,169.8086
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0603	0.0793	0.9447	1.5800e-003	0.1232	8.9000e-004	0.1241	0.0327	8.2000e-004	0.0335		125.0813	125.0813	7.1500e-003		125.2315
Total	**0.3790**	**2.9310**	**4.9603**	**0.0134**	**0.4133**	**0.0823**	**0.4957**	**0.1123**	**0.0757**	**0.1880**		**1,294.7548**	**1,294.7548**	**0.0136**		**1,295.0401**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	1.9074	20.2964	14.7270	0.0223		1.1384	1.1384		1.0473	1.0473	0.0000	2,281.0588	2,281.0588	0.6989		2,295.7360
Paving	0.6707					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Total	**2.5781**	**20.2964**	**14.7270**	**0.0223**		**1.1384**	**1.1384**		**1.0473**	**1.0473**	**0.0000**	**2,281.0588**	**2,281.0588**	**0.6989**		**2,295.7360**

3.6 Paving - 2017

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.3187	2.8517	4.0156	0.0118	0.2901	0.0815	0.3715	0.0796	0.0749	0.1545		1,169.6736	1,169.6736	6.4300e-003		1,169.8086
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0603	0.0793	0.9447	1.5800e-003	0.1232	8.9000e-004	0.1241	0.0327	8.2000e-004	0.0335		125.0813	125.0813	7.1500e-003		125.2315
Total	**0.3790**	**2.9310**	**4.9603**	**0.0134**	**0.4133**	**0.0823**	**0.4957**	**0.1123**	**0.0757**	**0.1880**		**1,294.7548**	**1,294.7548**	**0.0136**		**1,295.0401**

3.7 Architectural Coating - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Archit. Coating	127.9990					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Off-Road	0.2215	1.4567	1.2454	1.9800e-003		0.1156	0.1156		0.1156	0.1156		187.6320	187.6320	0.0198		188.0480
Total	**128.2205**	**1.4567**	**1.2454**	**1.9800e-003**		**0.1156**	**0.1156**		**0.1156**	**0.1156**		**187.6320**	**187.6320**	**0.0198**		**188.0480**

3.7 Architectural Coating - 2017

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.1166	0.1533	1.8263	3.0500e-003	0.2382	1.7300e-003	0.2400	0.0632	1.5900e-003	0.0648		241.8238	241.8238	0.0138		242.1143
Total	**0.1166**	**0.1533**	**1.8263**	**3.0500e-003**	**0.2382**	**1.7300e-003**	**0.2400**	**0.0632**	**1.5900e-003**	**0.0648**		**241.8238**	**241.8238**	**0.0138**		**242.1143**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Archit. Coating	127.9990					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Off-Road	0.2215	1.4567	1.2454	1.9800e-003		0.1156	0.1156		0.1156	0.1156	0.0000	187.6320	187.6320	0.0198		188.0480
Total	**128.2205**	**1.4567**	**1.2454**	**1.9800e-003**		**0.1156**	**0.1156**		**0.1156**	**0.1156**	**0.0000**	**187.6320**	**187.6320**	**0.0198**		**188.0480**

3.7 Architectural Coating - 2017

Mitigated Construction Off-Site

Category	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.1166	0.1533	1.8263	3.0500e-003	0.2382	1.7300e-003	0.2400	0.0632	1.5900e-003	0.0648		241.8238	241.8238	0.0138		242.1143
Total	**0.1166**	**0.1533**	**1.8263**	**3.0500e-003**	**0.2382**	**1.7300e-003**	**0.2400**	**0.0632**	**1.5900e-003**	**0.0648**		**241.8238**	**241.8238**	**0.0138**		**242.1143**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

Improve Pedestrian Network

Encourage Telecommuting and Alternative Work Schedules

Category	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
	lb/day										lb/day					
Mitigated	7.5209	17.4181	85.8941	0.1389	8.3271	0.2854	8.6125	2.2241	0.2626	2.4867		11,575.5684	11,575.5684	0.4343		11,584.6881
Unmitigated	7.6697	18.3248	89.5731	0.1481	8.9020	0.3040	9.2060	2.3777	0.2798	2.6574		12,343.4364	12,343.4364	0.4602		12,353.1001

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
General Office Building	1,750.59	376.83	155.82	3,170,041	2,965,305
Parking Lot	0.00	0.00	0.00		
Total	1,750.59	376.83	155.82	3,170,041	2,965,305

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
General Office Building	9.50	7.30	7.30	33.00	48.00	19.00	77	19	4
Parking Lot	9.50	7.30	7.30	0.00	0.00	0.00	0	0	0

LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
0.433084	0.067774	0.178855	0.157581	0.054931	0.008753	0.007036	0.074865	0.001146	0.001007	0.009750	0.000669	0.004549

4.4 Fleet Mix

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
NaturalGas Mitigated	0.0847	0.7700	0.6468	4.6200e-003		0.0585	0.0585		0.0585	0.0585		924.0193	924.0193	0.0177	0.0169	929.6428
NaturalGas Unmitigated	0.0847	0.7700	0.6468	4.6200e-003		0.0585	0.0585		0.0585	0.0585		924.0193	924.0193	0.0177	0.0169	929.6428

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
General Office Building	7854.16	0.0847	0.7700	0.6468	4.6200e-003		0.0585	0.0585		0.0585	0.0585		924.0193	924.0193	0.0177	0.0169	929.6428
Parking Lot	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0847**	**0.7700**	**0.6468**	**4.6200e-003**		**0.0585**	**0.0585**		**0.0585**	**0.0585**		**924.0193**	**924.0193**	**0.0177**	**0.0169**	**929.6428**

5.2 Energy by Land Use - NaturalGas

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	lb/day										lb/day					
General Office Building	7.85416	0.0847	0.7700	0.6468	4.6200e-003		0.0585	0.0585		0.0585	0.0585		924.0193	924.0193	0.0177	0.0169	929.6428
Parking Lot	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0847**	**0.7700**	**0.6468**	**4.6200e-003**		**0.0585**	**0.0585**		**0.0585**	**0.0585**		**924.0193**	**924.0193**	**0.0177**	**0.0169**	**929.6428**

6.0 Area Detail

6.1 Mitigation Measures Area

Use Low VOC Paint - Non-Residential Interior

Use Low VOC Paint - Non-Residential Exterior

Use Low VOC Cleaning Supplies

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	8.6224	3.7000e-004	0.0396	0.0000		1.4000e-004	1.4000e-004		1.4000e-004	1.4000e-004		0.0836	0.0836	2.3000e-004		0.0885
Unmitigated	9.2338	3.7000e-004	0.0396	0.0000		1.4000e-004	1.4000e-004		1.4000e-004	1.4000e-004		0.0836	0.0836	2.3000e-004		0.0885

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	1.0521					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	8.1780					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Landscaping	3.7800e-003	3.7000e-004	0.0396	0.0000		1.4000e-004	1.4000e-004		1.4000e-004	1.4000e-004		0.0836	0.0836	2.3000e-004		0.0885
Total	**9.2338**	**3.7000e-004**	**0.0396**	**0.0000**		**1.4000e-004**	**1.4000e-004**		**1.4000e-004**	**1.4000e-004**		**0.0836**	**0.0836**	**2.3000e-004**		**0.0885**

6.2 Area by SubCategory

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	1.0521					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	7.5666					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Landscaping	3.7800e-003	3.7000e-004	0.0396	0.0000		1.4000e-004	1.4000e-004		1.4000e-004	1.4000e-004		0.0836	0.0836	2.3000e-004		0.0885
Total	**8.6224**	**3.7000e-004**	**0.0396**	**0.0000**		**1.4000e-004**	**1.4000e-004**		**1.4000e-004**	**1.4000e-004**		**0.0836**	**0.0836**	**2.3000e-004**		**0.0885**

7.0 Water Detail

7.1 Mitigation Measures Water

Install Low Flow Bathroom Faucet

Install Low Flow Kitchen Faucet

Install Low Flow Toilet

Install Low Flow Shower

Use Water Efficient Irrigation System

Use Water Efficient Landscaping

8.0 Waste Detail

8.1 Mitigation Measures Waste

Institute Recycling and Composting Services

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Vegetation

APPENDIX D

INTEGRATED CULTURAL RESOURCES MANAGEMENT PLAN

DOCUMENT IS NOT ATTACHED TO THE EA -- AVAILABLE FOR OFFICIAL USE ONLY (FOUO)

APPENDIX E

INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN

DOCUMENT IS NOT ATTACHED TO THE EA BECAUSE IT IS AVAILABLE FOR OFFICIAL USE ONLY (FOUO)

APPENDIX F
BASEWIDE BIOLOGICAL OPINION

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ventura Fish and Wildlife Office
2493 Portola Road, Suite B
Ventura, California 93003

IN REPLY REFER TO:
08EVEN00-2014-F-0123

March 11, 2014

412 CE/CL
James E. Judkins
Base Civil Engineer
225 North Rosamond Boulevard
Edwards Air Force Base, California 93524

Subject: Biological Opinion for Operations and Activities at Edwards Air Force Base, California (8-8-14-F-14)

Dear Mr. Judkins:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion regarding the effects on the federally threatened desert tortoise (*Gopherus agassizii*) and its critical habitat, in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.), of all identified existing and future similar actions that are likely to occur on Edwards Air Force Base. This document also describes the criteria by which the U.S. Air Force will determine whether its actions are likely to adversely affect the desert tortoise or its critical habitat and our concurrence with actions that are undertaken within the framework of these criteria. We received your request for formal consultation on February 22, 2008.

This biological opinion is based on information which accompanied your request for consultation, conversations and correspondence with Edwards Air Force Base staff, and information contained in our files. A complete record of this consultation can be made available at the Ventura Fish and Wildlife Office.

Consultation History

Since 1990, the Air Force and Service have consulted formally on the effects of Air Force actions on the desert tortoise and its critical habitat 49 times; we have consulted informally on other actions. To date, we have completed consultations on a wide range of activities and uses, including recreational activities, construction and maintenance of infrastructure, remediation of contaminated sites, black box projects, and disposal of unstable rocket fuel. Prior to the initiation of formal consultation, staff from the Air Force and Service discussed the basic concepts of this base-wide consultation informally on several occasions.

On January 30, 2014, the Service (2014) provided the Air Force with a draft biological opinion. The Air Force (2014b) provided comments on the draft biological opinion on March 4, 2014; we have incorporated the Air Force's comments into this biological opinion, as appropriate.

ADMINISTRATION OF THE CONSULTATION

Future actions that may affect the desert tortoise or its critical habitat at Edwards Air Force Base will be evaluated in the following manner. The Environmental Management Office at Edwards Air Force Base will review all discretionary actions that the Air Force proposes on Edwards Air Force Base. Based on the nature of the activity, its potential to adversely affect desert tortoises or their critical habitat, and any measures that can be implemented to avoid or minimize the effect, the Air Force will determine whether the action will not affect, is not likely to adversely affect, or is likely to adversely affect the desert tortoise or its critical habitat.

The Air Force will maintain a record of all its activities that undergo this evaluation. For actions that do not affect or are not likely to adversely affect the desert tortoise or its critical habitat, the Air Force will include in its record:

1. The title of the action;
2. A description of the proposed action;
3. Location;
4. Size; and
5. The rationale that it used to reach its determination regarding effects to the desert tortoise or its critical habitat.

For actions that are likely to adversely affect the desert tortoise or its critical habitat, the Air Force will include in its record:

1. The title of the action;
2. A description of the proposed action;
3. Location;
4. Size;
5. The number of desert tortoises that are killed, injured, and moved from harm's way;
6. The amount of habitat disturbed or lost, with a notation as to whether the affected area was designated critical habitat;
7. A listed of authorized biologists who worked on actions covered by this consultation in the reporting year; and
8. A brief but comprehensive discussion of whether the protective measures were effective. If the measures were not effective, the Air Force will explain why the measures did not function as expected and recommendations for implementing more effective measures.

In past consultations with the Air Force, the Service has authorized biologists to implement protective measures and handle desert tortoises on a project-by-project basis. Upon completion of this consultation, the Air Force will not request such authorization on a project-by-project basis. From this point, any person that is approved by the Service to undertake the duties of an authorized biologist for actions proposed by the Air Force that are covered by this biological

opinion may also perform those duties on future actions. If the Air Force determines that an authorized biologist is not performing his or her duties in a satisfactory manner, the Air Force will notify the Service at the earliest possible time it makes this determination.

The Service and Air Force agree that some actions may be proposed in the future that may result in effects beyond the scope of those considered in this biological opinion. In the case of such actions, the Air Force and Service will discuss whether this biological opinion sufficiently considered effects to the desert tortoise and its critical habitat in light of the proposed action and whether re-initiation of formal consultation or initiation of a separate consultation is appropriate.

If staff from the Service and Air Force cannot agree on a course of action after discussions on this or other issues, any disagreement will be elevated to the Ventura Fish and Wildlife Office's Assistant Field Supervisor and the Air Force Civil Engineer Director and/or Environmental Management Division Chief for resolution. If further elevation is required, the Field Supervisor of the Ventura Fish and Wildlife Office and the Installation Commander of Edwards Air Force Base will be contacted to resolve the issue. Although the elevation of issues is likely to be an infrequent occurrence, the Air Force and Service consider this procedure to be a useful tool to maintain efficient processes and a healthy working relationship between our agencies.

The Air Force will provide the Service with an annual report of the activities that it conducts under the auspices of this consultation. The annual report will include the information that the Air Force will maintain in its records for any activity it determined was likely to adversely affect the desert tortoise or its critical habitat, as described in this section. The annual report will be provided to the Service by January 31 of each year this biological opinion is in effect.

The annual report will also contain information on conservation activities that the Air Force undertook in the previous year. Such activities may include, but are not limited to, acquisition of land through the Readiness and Environmental Preparedness Initiative, results of research on desert tortoises conducted or funded by the Air Force, and the results of relevant research conducted under the Air Force's Small Business Initiative.

The Ventura Fish and Wildlife Office's Assistant Field Supervisor, the Air Force Civil Engineer Director and/or Environmental Management Division Chief, and appropriate staff will meet annually to review how this consultation is functioning and to discuss any potentially important events in the upcoming year. This meeting could be held in conjunction with the quarterly meeting of the Desert Managers Group that occurs nearest the time the annual report is due. If the Service and Air Force agree that such a meeting is unnecessary in any given year, the meeting may be cancelled.

Criteria for Use in Reaching Appropriate Determinations

The Air Force will use the following outline to determine the appropriate level of consultation required for each proposed action.

1) Projects in which any effects would occur outside of desert tortoise habitat would have no effect on the species; the Air Force will document its determinations in these situations for its own records but would not need to contact the Ventura Fish and Wildlife Office. If the Air Force requires technical assistance from the Service to determine if suitable habitat for desert tortoises would be affected, it should contact us by phone or electronic mail.

2) If the following criteria are met, a determination of not likely to adversely affect the desert tortoise would be appropriate:

   a) The project is within habitat of the desert tortoise;

   b) Desert tortoise habitat is present, but degraded or disturbed, in the project area. For the purposes of this consultation, the Air Force and Service consider degraded habitat to be that habitat which has been affected by previous activities. Degraded habitat will generally exhibit a lower diversity and density of native shrubs and disrupted substrates than undisturbed habitat. The Air Force and Service may consider certain washes to be disturbed habitat; the fundamental guidance in such areas is that the evidence of the maintenance activity would no longer be visible after an event where water flows in the wash. The loss or disturbance of a minor amount of undisturbed habitat may also be considered as being not likely to adversely affect the species, when considered with regard to its distribution in the action area; and

   c) Neither desert tortoises nor their diagnostic sign are observed during surveys or a habitat assessment.

   In cases where a determination is not entirely clear from a verbal description, the Air Force will provide the Service with a photograph (aerial or otherwise, as appropriate) of the project site to assist in its determination.

3) If the following criteria are met, a determination of not likely to adversely affect critical habitat for the desert tortoise would be appropriate:

   a) The project is within designated critical habitat, but the primary constituent elements of desert tortoise critical habitat are not present;

   b) The primary constituent elements would not be affected by the proposed project; or

   c) Effects to the primary constituent elements would be so minor that they are not substantially measurable when considered within the context of the critical habitat unit. Such effects may occur, for example, when a narrow strip of land supporting the primary constituent elements of critical habitat at the edge of an existing road may be affected by an action.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The Air Force requested consultation on a variety of mission support actions, including recurring and predicted new projects and future unknown projects. For this biological opinion, we worked with the Air Force to assess the threats to desert tortoises and their critical habitat associated with each type of proposed activity. Future actions under the control of the Air Force are expected to cause impacts that are similar to those discussed in the biological evaluation. The following table lists the Air Force's activities and notes the general manner by which the activity would affect the desert tortoise and its critical habitat (e.g., ground disturbance, use of roads, etc.). We will then consider more specifically the nature of these effects on the desert tortoise and its critical habitat and the measures that the Air Force has proposed to avoid, reduce, or minimize these effects. The biological evaluation contains a more detailed description of its proposed activities (Air Force 2008a).

Table 1 - Threats and Associated Activities of Proposed Actioin

		Driving off-road	Driving on road	Ground Disturbance	Explosions (potential for fire)	Non-native Plants	Common Ravens	Moving desert tortoise from harm	Personnel on Foot	Habitat Conversion
Range Flight Operations	Desert tortoise	N	Y	Y	Y	N	N	N	N	N
	Critical Habitat	N	Y	Y	Y	N	N	N	N	N
Airfield Flight Operations	Desert tortoise	N	N	N	N	N	N	N	N	N
	Critical Habitat					N/A				
Range Ground Operations	Desert tortoise	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Critical Habitat	Y	Y	Y	Y	Y	Y	Y	Y	Y
Directed Energy Operations	Desert tortoise	N	Y	N	Y	N	N	N	Y	N
	Critical Habitat	N	Y	N	Y	N	N	N	Y	N
Ordnance Expenditures	Desert tortoise	Y	Y	Y	y	N	N	Y	Y	N
	Critical Habitat	Y	Y	Y	Y	N	N	Y	Y	N
Energetic Material Expenditures	Desert tortoise	N	Y	N	y	N	N	Y	Y	N
	Critical Habitat	N	Y	N	Y	N	N	Y	Y	N
Native American Uses	Desert tortoise	N	Y	N	N	N	N	N	N	N
	Critical Habitat	N	Y	N	N	N	N	N	N	N
Research and Education	Desert tortoise	N	Y	N	N	N	N	Y	Y	N
	Critical Habitat	N	Y	N	N	N	N	Y	Y	N
Recreation	Desert tortoise	Y	Y	N	N	N	N	Y	Y	N
	Critical Habitat					N/A				
Feral Grazing Management	Desert tortoise	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Critical Habitat	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Monitoring	Desert tortoise	Y	N	Y	N	N	Y	Y	Y	Y
	Critical Habitat	Y	N	Y	N	N	Y	Y	Y	Y
Inventories/Surveys	Desert tortoise	Y	N	Y	N	Y	Y	N	Y	N
	Critical Habitat	Y	N	Y	N	Y	Y	N	Y	N
Utility Maintenance	Desert tortoise	Y	Y	Y	Y	N	N	Y	Y	N
	Critical Habitat	Y	Y	Y	Y	N	N	Y	Y	Y
Fire Management	Desert tortoise	Y	Y	Y	N	N	N	Y	Y	N
	Critical Habitat	Y	Y	Y	N	N	N	Y	Y	Y
Future Development	Desert tortoise	Y	Y	Y	N	Y	Y	Y	Y	Y
	Critical Habitat	Y	Y	Y	Y	Y	Y	Y	Y	Y

Y = Associated activity may affect the desert tortoise or its critical habitat in this manner. (Activities would affect critical habitat and habitat not designated as critical in the same basic manner; however, we do not consider effects to non-critical habitat in assessing whether a proposed action is likely to destroy or adversely modify critical habitat.)

N = Associated activity does not affect the desert tortoise or its critical habitat.

N/A = Associated activity does not occur in area of concern (desert tortoise habitat or critical habitat).

The Air Force anticipates that it may need 20,000 acres for future development of solar facilities, infrastructure, and mission activities and operations. The Air Force estimates that up to 5,000 acres of new disturbance may occur within critical habitat and 15,000 acres may occur outside of critical habitat. The Air Force would manage desert tortoises during the course of future development by following its integrated natural resources management plan.

The construction and operation of the Oro Verde Solar Project would occur within the boundaries of Edwards Air Force Base; this solar plant would require an interconnecting power line (gen-tie line) to the Windhub Substation, which lies to the northwest of base. For this reason, the Air Force requested that the Service also consider the effects of the construction and operation of the gen-tie line on the desert tortoise in this biological opinion. (The gen-tie line would not affect critical habitat; the nearest critical habitat for the desert tortoise is approximately 20 miles to the east of the easternmost portion of the gen-tie line.) The method used to construct the gen-tie line would occur in a manner similar to how the Air Force (or service companies operating within the base) would maintain utilities, although the impacts of construction would be more intense than would occur during maintenance.

To ensure that its activities do not result in numerous injuries to or mortalities of desert tortoises, the Air Force has proposed a set of thresholds that, if reached, will prompt additional action on its part to protect desert tortoises (Reinke 2009, Mull 2013a). If a desert tortoise is injured or killed in a calendar year, the Air Force will retrain those individuals that were responsible for implementing the activity, determine how to avoid future injuries or mortalities, and implement appropriate measures to reduce the number of future injuries or mortalities. The Air Force will also determine the root cause of the activities that resulted in the injury or mortality, determine appropriate measures to reduce, to the maximum extent possible, future injury or mortality, and obtain the Service's concurrence on implementation of the measures. Finally, the Air Force has proposed to re-initiate formal consultation if five desert tortoises are killed or injured in a calendar year.

The Air Force has also proposed to re-initiate formal consultation if the amount of desert tortoise habitat disturbed by its activities reaches 15,000 acres in the portion of Edwards Air Force Base that is outside of the boundaries of critical habitat. For the portion of the base within the boundaries of critical habitat, the Air Force has proposed to re-initiate formal consultation if the amount of desert tortoise habitat disturbed by its activities reaches 5,000 acres. The Air Force has been restoring lands disturbed by its activities so that these areas can support their ecological functions; the Air Force has also proposed to evaluate the effectiveness of its restoration activities and to subtract the acreage of restored habitat from the acreage of disturbed habitat as it monitors the activities it conducts under the auspices of this consultation. For example, if, in any given year, the Air Force disturbs 10 acres during its activities and restores 3 acres, the cumulative loss of habitat for the year would be 7 acres. For the purposes of tracking whether re-initiation is required, the Air Force will track the amount of habitat disturbed and restored upon completion of this biological opinion. Previously disturbed areas are not considered to be desert tortoise habitat for the purpose of tracking habitat loss; for example, any disturbance within the bed of an unpaved road would not be considered disturbance of desert tortoise habitat

because the biological and physical attributes of habitat are generally absent from such disturbed areas.

Adaptive Management Strategy

The Air Force has proposed three primary goals for its adaptive management strategy: 1) ensure that mission-related activities are conducted in compliance with Federal and State natural resource and other environmental legislation; 2) assess and monitor populations of listed, proposed, and sensitive species and general habitat conditions over time; and 3) ensure the long-term viability of desert tortoise populations within the Fremont-Kramer Desert Wildlife Management Area, while fully supporting the military mission at Edwards Air Force Base (Air Force 2008a). These goals apply to the annual and 5-year revisions of Edwards Air Force Base's integrated natural resources management plans.

Protective Measures

The Air Force has implemented a set of standardized minimization measures derived from numerous biological opinions to protect desert tortoises and conserve their habitat. These measures are applied selectively through the National Environmental Policy Act process via the Air Force Environmental Impact Analysis Process for each ground-disturbing action. The Air Force will continue implementing these minimization measures in the future as new types of projects occur in new areas that are expected to have similar impacts from mission activities.

a. Desert tortoises will be handled in full accordance with all applicable provisions and regulations of the Endangered Species Act. The phrases "authorized biologist" and "desert tortoise monitor", as used in this section are taken from the most up-to-date Service guidance (Service 2010a) and defined as follows:

    1. Authorized biologists must have thorough and current knowledge of desert tortoise behavior, natural history, ecology, and physiology, and demonstrate substantial field experience and training to safely and successfully conduct their required duties. Authorized biologists are approved to monitor project activities within desert tortoise habitat and are responsible for locating desert tortoises and their sign (i.e., conduct clearance surveys). Authorized biologists must ensure proper implementation of protective measures, and make certain that the effects of the project on the desert tortoise and its habitat are minimized in accordance with a biological opinion or incidental take permit. All incidents of noncompliance in accordance with the biological opinion or permit must be recorded and reported.

    2. Desert tortoise monitors will be approved by the authorized biologist to monitor project activities within desert tortoise habitat, ensure proper implementation of protective measures, and record and report desert tortoise and sign observations in accordance with approved protocol. They will report incidents of noncompliance in accordance with a biological opinion or permit, move desert tortoises from harm's way when desert tortoises enter project sites and place these animals in "safe areas"

pre-selected by authorized biologists or maintain the desert tortoises in their immediate possession until an authorized biologist assumes care of the animal. Desert tortoise monitors assist authorized biologists during surveys and serve as "apprentices" to acquire experience. Monitors should not conduct clearance surveys or other specialized duties of the authorized biologist unless directly supervised by an authorized biologist; “directly supervised” means the authorized biologist has direct voice and sight contact with the monitor. The desert tortoise monitor may directly supervise other personnel to assist with surveying for desert tortoises when deemed necessary.

3. None of the proposed measures will prohibit any individual from handling a desert tortoise when necessary to protect the safety or health of the animal.

b. Authorized biologists are the only individuals approved to handle desert tortoises on base. The Service’s standardized form will be used for individuals to work on specific projects to verify the capabilities and experience of the potential desert tortoise biologist.

c. All base personnel (including contractors, civilian, and military employees) will be provided, at a minimum, a description of the desert tortoise, its status, and measures to minimize impacts. The material may also include the use of a multimedia presentation (videotape and printed material).

d. To the maximum extent practicable, activities will be sited to avoid effects to desert tortoises and their habitat.

e. Personnel will immediately report sightings of desert tortoises or sign found in the project area to the authorized biologist, desert tortoise monitor, or the Environmental Management Office.

f. Pre-activity surveys will be conducted, where deemed necessary, in project areas prior to ground-disturbing activities.

g. The project work areas will be fenced, flagged, or marked to define the limit of project activities.

h. Vehicles will generally remain on previously established roads and within staging areas and follow flagged off road routes that have been surveyed or cleared of desert tortoises. When driving off road, operators will minimize disturbance to vegetation and not exceed 10 miles per hour. All personnel will inspect under vehicles for desert tortoises prior to operating them in desert tortoise habitat.

i. Open excavations will be checked three times a day and authorized personnel will remove any trapped animals. Open excavations will be covered, backfilled, or fenced at the end of each workday. At the ends of a ditch or trench, a 3:1 slope will be created to allow wildlife to exit should they become trapped in the ditch or trench. All open excavations that are left unattended will be fenced, unless other methods of excluding desert tortoises are employed.

j. Any pipes left or stored on the ground in the project area will be capped on the ends to prevent entry by desert tortoises or other wildlife.

k. Parking and staging areas will be restricted to previously disturbed areas as much as possible.

l. Acres of disturbance will be tracked to provide a basis for possible future re-vegetation and restoration efforts.

m. All trash and food items will be disposed of in common raven-proof containers, and regularly removed from project sites to reduce attraction of common ravens.

n. Project activities between dusk and dawn will be confined to areas free of vegetation and cleared of desert tortoises by authorized personnel.

o. An annual report will be submitted to the Service summarizing any injury, mortality, or handling of desert tortoises, disturbance of critical habitat, and habitat restoration.

<u>Other Measures Implemented for Specific Activities</u>

The following minimization measures are being implemented to aid overall management of the desert tortoise on base.

Motorized Recreation Areas

a. Signs will be maintained along the designated off-road vehicle area boundaries.

b. Bulletin boards displaying up-to-date rules and safety information will be placed at the main access areas at each off-road vehicle area.

c. Law Enforcement personnel will patrol the areas to ensure that riders remain within the boundaries and use existing trails.

d. All operators of motor vehicles will take desert tortoise awareness training and carry proof of training when riding.

e. Environmental Management will monitor and record habitat disturbance. Solutions to problems that may develop will be suggested by the off-road vehicle area subcommittee and implemented by the Air Force.

Non-motorized Recreation Areas

a. Signs, notices, and other media will be used to inform personnel that use of off-road vehicle area 3 requires desert tortoise awareness training.

b. Desert tortoises crossing trails will not be moved; bikers and joggers will wait until the desert tortoise moves off the trail.

c. Activities will occur on established trails.

d. Pets not on leashes will not be allowed in the non-motorized recreation area.

Road Construction and Maintenance

a. All drainage recontouring will be limited to the greatest extent possible to reduce habitat fragmentation, where practicable.

b. Maintenance of drainage ditches will not be altered to change the direction of stormwater runoff from existing conditions to avoid potential flooding of desert tortoise burrows downslope of maintenance activities to the greatest extent possible.

c. Herbicide applicators will be instructed to watch for desert tortoises on road shoulders and to take precautions, as necessary, to ensure that no desert tortoises are sprayed.

d. Fugitive dust generated during construction will be controlled with water; the amount of water used will be restricted to the minimum amount required to maintain air quality standards.

e. Water tanks and trucks will be maintained in good working order and free of leaks so common ravens will not be attracted to standing water.

f. Installation of fencing along roadways will be implemented in areas deemed hazardous to desert tortoises to prevent injury or mortality.

Utilities

a. Aboveground gas lines will be placed at least 18 inches aboveground when they traverse desert tortoise habitat.

b. If, at any time after installation, the height of the gas pipes above the ground has been reduced to less than 18 inches, the pipelines will either be raised or the materials causing the reduction will be removed.

c. Lands above underground utilities will be re-vegetated unless a road needs to be constructed and maintained for access and maintenance activities.

d. Roads needed for utility maintenance will be concentrated in previously established corridors when possible.

e. Underground utilities will be located adjacent to or within previously disturbed areas when possible.

Re-vegetation

a. Habitat restoration required under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended under the Superfund Amendments and Reauthorization Act of 1986 for mission related ground disturbance would include using techniques to control soil erosion that have been proven successful in the desert environment and will also include use of native plants and seeds in an attempt to mimic natural biodiversity.

b. Priority for re-vegetation will be given to desert tortoise critical habitat.

c. Restoration activities will be conducted in accordance with the re-vegetation plans prepared by Edwards Air Force Base (Air Force 1994; Air Force 2012) and any new scientifically proven methodology.

d. Monitoring success of efforts will be implemented for a longer period than the standard 5-year monitoring period due to slow recovery rates of re-vegetated areas in the desert.

Management of Common Ravens

The Air Force will implement protective measures to reduce the adverse effects associated with predation of desert tortoises by common ravens. In general, the Air Force proposes to manage common ravens by controlling the use of landfills and sewage ponds, designing facilities to discourage common raven use, minimizing or eliminating food and water subsidies, providing training to on-site personnel, monitoring the presence of common ravens and their use of subsidies, and studying common raven predation on juvenile tortoises. The biological evaluation (Air Force 2008a) and integrated natural resource management plan (Air Force 2008b) contain more detailed information on these management actions.

Relocation of Desert Tortoises

In the event that future development or activities would result in the clearing of a large area of suitable desert tortoise habitat, the Air Force would relocate desert tortoises from these sites to other habitat. The Air Force will monitor all translocated desert tortoises to determine the success of the relocation.

Monitoring of the Desert Tortoise Population

Since 1988, Environmental Management has conducted numerous surveys for desert tortoises. The Air Force monitors desert tortoise populations using data collected by researchers and consultants who conduct studies or monitor projects on base. The Air Force uses these data to update database files and various Geographic Information System databases and spreadsheets to facilitate effective management of desert tortoises on base. It will thoroughly analyze and evaluate existing data and provide an up-to-date status of the current estimated distribution,

abundance, and trends of the on-base population of desert tortoises. Currently, the density of the tortoise population on base is unknown.

Long-Term Monitoring of Ecological Trends

The protection, restoration, and conservation of desert habitat are an ongoing management process at Edwards Air Force Base. One key component of this process is the ability to check progress against established benchmarks and use this information to develop effective management strategies that are expected to change over time. As part of the habitat quality analysis studies initiated at Edwards Air Force Base in 1992, the Air Force established 60 long-term monitoring plots to determine baseline conditions of habitat quality and to monitor long-term trends of habitat quality and species diversity. Periodic vegetation and wildlife surveys provide the benchmarks to evaluate environmental change. Each restored area is analyzed in comparison to 3 or 4 study sites with similar habitat characteristics (Reinke 2013). Information obtained from the long-term study plots and natural restoration are also used to determine habitat stability and support the regional desert tortoise recovery effort and the goals and objectives of Edwards Air Force Base's integrated natural resources management plan (Air Force 2008b).

The primary purpose of the integrated natural resources management plan for Edwards Air Force Base is "to implement natural resource management practices that strive to maintain or enhance habitat quality of the installation's natural resources resulting in stabilizing and/or increasing the biodiversity of the desert environment" (Air Force 2008b). The Air Force intends to achieve this purpose through the goals identified in the integrated natural resources management plan, which include but are not limited to monitoring of natural resources, collection of data, management of invasive species, conservation of habitat, and increasing the environmental awareness of all base personnel. The integrated natural resources management plan calls for the meeting of these goals "… in concert with other base organizations, and their programs and plans while ensuring no net loss to the capability of the military mission' (Air Force 2008b).

ANALYTICAL FRAMEWORK FOR THE JEOPARDY AND ADVERSE MODIFICATION DETERMINATIONS

Jeopardy Determination

Section 7(a)(2) of the Endangered Species Act requires that Federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of listed species. "Jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 Code of Federal Regulations 402.02).

The jeopardy analysis in this biological opinion relies on four components: (1) the Status of the Species, which describes the range-wide condition of the desert tortoise, the factors responsible for that condition, and its survival and recovery needs; (2) the Environmental Baseline, which analyzes the condition of the desert tortoise in the action area, the factors responsible for that

condition, and the relationship of the action area to the survival and recovery of the desert tortoise; (3) the Effects of the Action, which determine the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the desert tortoise; and (4) the Cumulative Effects, which evaluate the effects of future, non-federal activities in the action area on the desert tortoise.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed federal action in the context of the current status of the desert tortoise, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the desert tortoise in the wild.

Adverse Modification Determination

Section 7(a)(2) of the Endangered Species Act requires that Federal agencies ensure that any action they authorize, fund, or carry out is not likely to result in the destruction or adverse modification of the critical habitat of listed species. This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 Code of Federal Regulations 402.02. Instead, we have relied on the statutory provisions of the Act to complete the following analysis with respect to critical habitat.

In accordance with policy and regulation, the adverse modification analysis in this biological opinion relies on four components: (1) the Status of Critical Habitat, which describes the range-wide condition of designated critical habitat for the desert tortoise in terms of primary constituent elements, the factors responsible for that condition, and the intended recovery function of the critical habitat overall; (2) the Environmental Baseline, which analyzes the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area; (3) the Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated and interdependent activities on the primary constituent elements and how that will influence the recovery role of the affected critical habitat units; and (4) Cumulative Effects, which evaluates the effects of future non-federal activities in the action area on the primary constituent elements and how that will influence the recovery role of affected critical habitat units.

For purposes of the adverse modification determination, the effects of the proposed Federal action on the critical habitat of the desert tortoise are evaluated in the context of the range-wide condition of the critical habitat, taking into account any cumulative effects, to determine if the critical habitat range-wide would remain functional (or would retain the current ability for the primary constituent elements to be functionally established in areas of currently unsuitable but capable habitat) to serve its intended recovery role for the desert tortoise.

STATUS OF THE DESERT TORTOISE AND CRITICAL HABITAT

Status of the Desert Tortoise

Section 4(c)(2) of the Act requires the Service to conduct a status review of each listed species at least once every five years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review); these reviews, at the time of their completion, provide the most up-to-date information on the range-wide status of the species. For this reason, we are appending the 5-year review of the status of the desert tortoise (Appendix 1; Service 2010b) to this biological opinion and are incorporating it by reference to provide most of the information needed for this section of the biological opinion. The following paragraphs provide a summary of the relevant information in the 5-year review.

In the 5-year review, the Service discusses the status of the desert tortoise as a single distinct population segment and provides information on the Federal Register notices that resulted in its listing and the designation of critical habitat. The Service also describes the desert tortoise's ecology, life history, spatial distribution, abundance, habitats, and the threats that led to its listing (i.e., the 5-factor analysis required by section 4(a)(1) of the Act). In the 5-year review, the Service concluded by recommending that the status of the desert tortoise as a threatened species be maintained.

With regard to the status of the desert tortoise as a distinct population segment, the Service concluded in the 5-year review that the recovery units recognized in the original and revised recovery plans (Service 1994a and 2011a, respectively) do not qualify as distinct population segments under the Service's distinct population segment policy (61 Federal Register 4722; February 7, 1996). We reached this conclusion because individuals of the listed taxon occupy habitat that is relatively continuously distributed, exhibit genetic differentiation that is consistent with isolation-by-distance in a continuous-distribution model of gene flow, and likely vary in behavioral and physiological characteristics across the area they occupy as a result of the transitional nature of, or environmental gradations between, the described subdivisions of the Mojave and Colorado deserts.

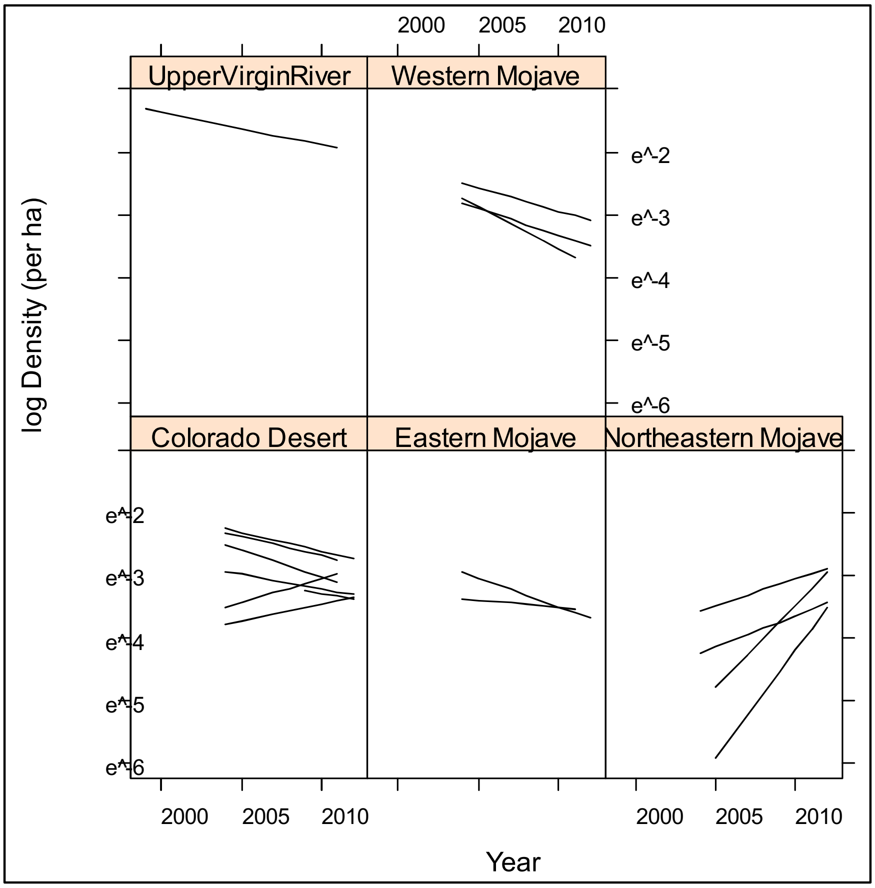
In the 5-year review, the Service summarizes information with regard to the desert tortoise's ecology and life history. Of key importance to assessing threats to the species and to developing and implementing a strategy for recovery is that desert tortoises are long lived, require up to 20 years to reach sexual maturity, and have low reproductive rates during a long period of reproductive potential. The number of eggs that a female desert tortoise can produce in a season is dependent on a variety of factors including environment, habitat, availability of forage and drinking water, and physiological condition. Predation seems to play an important role in clutch failure. Predation and environmental factors also affect the survival of hatchlings.

In the 5-year review, the Service also discusses various means by which researchers have attempted to determine the abundance of desert tortoises and the strengths and weaknesses of those methods. Due to differences in area covered and especially to the non-representative

nature of earlier sample sites, data gathered by the Service's current range-wide monitoring program cannot be reliably compared to information gathered through other means at this time.

The Service provides a summary table of the results of range-wide monitoring, initiated in 2001, in the 5-year review. This ongoing sampling effort is the first comprehensive attempt to determine the densities of desert tortoises across their range. Table 1 of the 5-year review provides a summary of data collected from 2001 through 2007; we summarize data from the 2008 through 2012 sampling efforts in subsequent reports (Service 2012a, 2012b, 2012c, 2012d).

The Service's Desert Tortoise Recovery Office (2014) used annual density estimates to compare a set of models that describe abundance patterns based on linear and quadratic response over time, spatial variation between desert tortoise conservation areas (e.g., national parks, desert wildlife management areas, the Desert Tortoise Natural Area, etc.) and recovery units, and survey team experience. The best model describing range-wide patterns in desert tortoise densities indicated different linear trends in different recovery units (see following figure); an effective training program precluded effects of surveyor experience or the lack thereof. In the original recovery plan for the desert tortoise, the Service (1994a) expected monitoring to detect increasing population trends of no more than 2 percent per year over a 25-year period. The Service has found much larger annual increases (greater than 19.7 percent) in the Northeastern Mojave Recovery Unit since 2004, with the rate of increase apparently resulting from increased survival of adults and subadults moving into the adult size class. The weight of evidence indicates that populations in the other 4 recovery units are declining: Upper Virgin River (-5.1 percent), Eastern Mojave (-5.8 percent), Western Mojave (-9.8 percent), and Colorado Desert (-2.4 percent; however, 2 desert tortoise conservation areas within this unit seem to be increasing).



Allison (2013) also evaluated changes in size distribution of desert tortoises since 2001. In the Western Mojave, Eastern Mojave, and Colorado Desert recovery units, the median size of large individuals has increased, indicating less recruitment of younger (therefore smaller) desert tortoises. In the Western Mojave and Colorado Desert recovery units, the relative number of smaller desert tortoises is about half what it was in 2001. Taken together, these trends suggest fewer small desert tortoises are reaching sexual maturity, which may be explained because they comprise a smaller proportion of the population or possibly because their survival rates are relatively lower than those of adults. Either possibility indicates that smaller size classes, like adults, are affected by ongoing threats; however, because most small desert tortoises die before reaching 180 millimeters in length, we do not know whether the reduced number of small animals has directly contributed to the observed declining trends in adults. For instance, a small increase in adult mortality would have a much larger effect on adult densities. None of these demographic rates have been measured in parallel with this study, so we cannot point to specific demographic rates that are associated with these overall population declines.

In the 5-year review, the Service provides a brief summary of habitat use by desert tortoises; more detailed information is available in the revised recovery plan (Service 2011a). In the absence of specific and recent information on the location of habitable areas of the Mojave Desert, especially at the outer edges of this area, the 5-year review also describes and relies heavily on a quantitative, spatial habitat model for the desert tortoise north and west of the Colorado River that incorporates environmental variables such as precipitation, geology,

heavily on a quantitative, spatial habitat model for the desert tortoise north and west of the Colorado River that incorporates environmental variables such as precipitation, geology, vegetation, and slope and is based on occurrence data of desert tortoises from sources spanning more than 80 years, including data from the 2001 to 2005 range-wide monitoring surveys (Nussear et al. 2009). The model predicts the probability that desert tortoises will be present in any given location; calculations of the amount of desert tortoise habitat in the 5-year review and in this biological opinion use a threshold of 0.5 or greater predicted value for potential desert tortoise habitat. The model does not account for anthropogenic effects to habitat and represents the potential for occupancy by desert tortoises absent these effects.

To begin integrating anthropogenic activities and the variable risk levels they bring to different parts of the Mojave and Colorado deserts, the Service completed an extensive review of the threats known to affect desert tortoises at the time of their listing and updated that information with more current findings in the 5-year review. The review follows the format of the five-factor analysis required by section 4(a)(1) of the Act. The Service described these threats as part of the process of its listing (55 Federal Register 12178; April 2, 1990), further discussed them in the original recovery plan (Service 1994a), and reviewed them again in the revised recovery plan (Service 2011a).

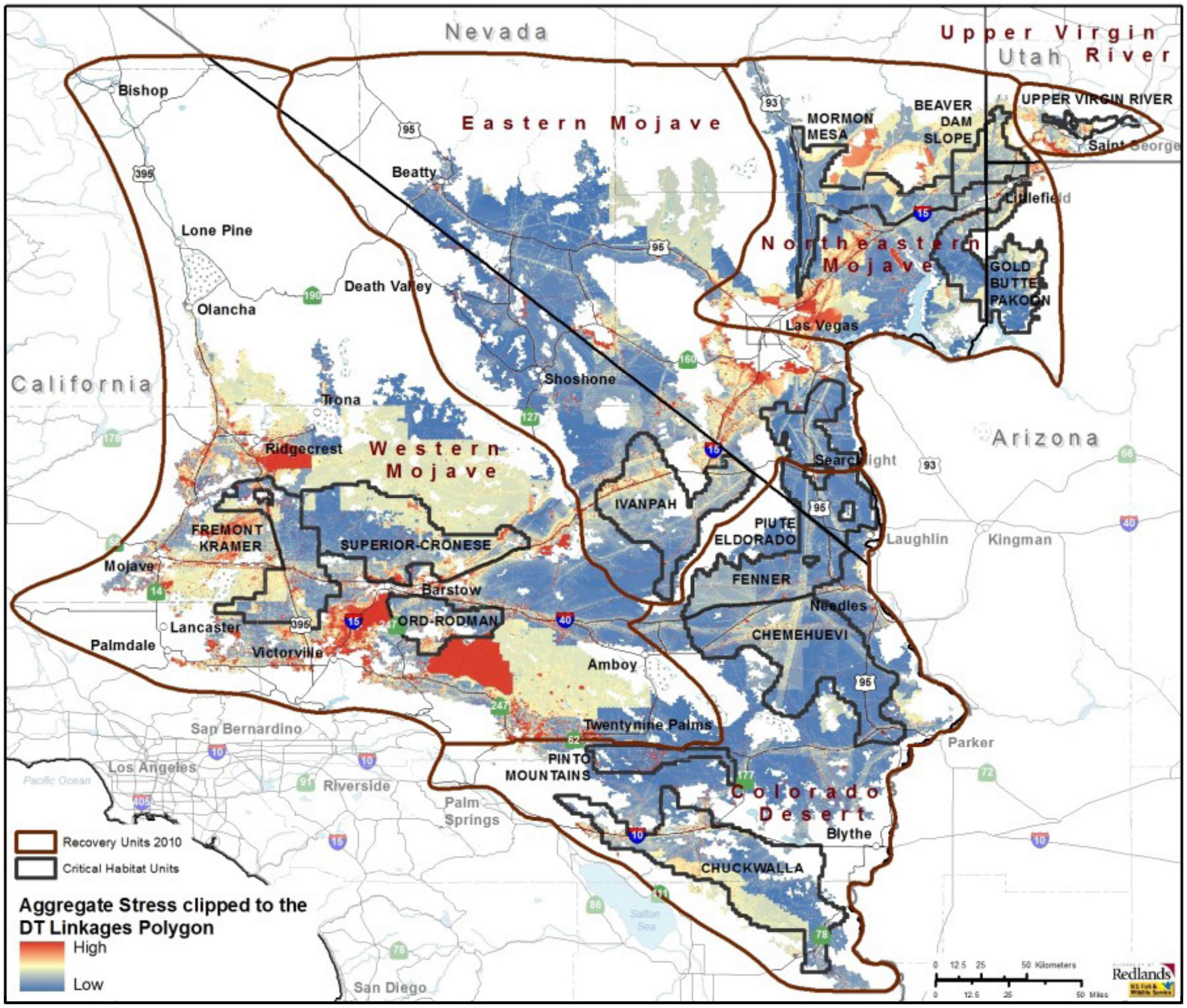
To understand better the relationship of threats to populations of desert tortoises and the most effective manner to implement recovery actions, the Desert Tortoise Recovery Office is developing a spatial decision support system that models the interrelationships of threats to desert tortoises and how those threats affect population change. The spatial decision support system describes the numerous threats that desert tortoises face, explains how these threats interact to affect individual animals and habitat, and how these effects in turn bring about changes in populations. For example, we have long known that the construction of a transmission line can result in the death of desert tortoises and loss of habitat. We have also known that common ravens, known predators of desert tortoises, use the transmission line's pylons for nesting, roosting, and perching and that the access routes associated with transmission lines provide a vector for the introduction and spread of invasive weeds and facilitate increased human access into an area. Increased human access can accelerate illegal collection and release of desert tortoises and their deliberate maiming and killing, as well as facilitate the spread of other threats associated with human presence, such as vehicle use, garbage and dumping, and invasive plants (Service 2011a). Changes in the abundance of native plants because of invasive weeds can compromise the physiological health of desert tortoises, making them more vulnerable to drought, disease, and predation. The spatial decision support system allows us to map threats across the range of the desert tortoise and model the intensity of stresses that these multiple and combined threats place on desert tortoise populations.

The threats described in the listing rule and both recovery plans continue to affect the species. Indirect impacts to desert tortoise populations and habitat occur in accessible areas that interface with human activity. Most threats to the desert tortoise or its habitat are associated with human land uses; research since 1994 has clarified many mechanisms by which these threats act on desert tortoises. As stated earlier, increases in human access can accelerate illegal collection and

release of desert tortoises and deliberate maiming and killing, as well as facilitate the spread of other threats associated with human presence, such as vehicle use, garbage and dumping, and invasive weeds.

Some of the most apparent threats to the desert tortoise are those that result in mortality and permanent habitat loss across large areas, such as urbanization and large-scale renewable energy projects, and those that fragment and degrade habitats, such as proliferation of roads and highways, off-highway vehicle activity, and habitat invasion by non-native invasive plant species. However, we remain unable to quantify how threats affect desert tortoise populations. The assessment of the original recovery plan emphasized the need for a better understanding of the implications of multiple, simultaneous threats facing desert tortoise populations and of the relative contribution of multiple threats on demographic factors (i.e., birth rate, survivorship, fecundity, and death rate; Tracy et al. 2004).

The following map depicts the 12 critical habitat units of the desert tortoise, linkages between conservation areas for the desert tortoise, and the aggregate stress that multiple, synergistic threats place on desert tortoise populations. Conservation areas include designated critical habitat, lands managed by the National Park Service, and other lands managed for the long-term conservation of the desert tortoise (e.g., the Desert Tortoise Natural Area in Kern County, California). The revised recovery plan (Service 2011a) recommended the linkages based on an analysis of least-cost pathways (i.e., areas with the highest potential to support desert tortoises) between conservation areas for the desert tortoise. This map illustrates that, across the range, desert tortoises in areas under the highest level of conservation management remain subject to numerous threats, stresses, and mortality sources.



Since the completion of the 5-year review, the Service has issued several biological opinions that affect large areas of desert tortoise habitat because of numerous proposals to develop renewable energy within its range. These biological opinions concluded that proposed solar plants were not likely to jeopardize the continued existence of the desert tortoise primarily because they were located outside of critical habitat and desert wildlife management areas that contain most of the land base required for the recovery of the species. The proposed actions also included numerous measures intended to protect desert tortoise during the construction of the projects, such as translocation of affected individuals. In aggregate, these projects would result in an overall loss of approximately 37,503 acres of habitat of the desert tortoise. We also predicted that these projects would translocate or kill up to 1,732 desert tortoises; we concluded that most of the individuals in these totals would be juveniles. To date, 372 desert tortoises have been observed during construction of projects; most of these individuals were translocated from work areas, although some desert tortoises have been killed (see appendix 2). The mitigation required by the Bureau and California Energy Commission, the agencies permitting these facilities, will result in the acquisition of private land within critical habitat and desert wildlife management areas and funding for the implementation of various actions that are intended to promote the recovery of

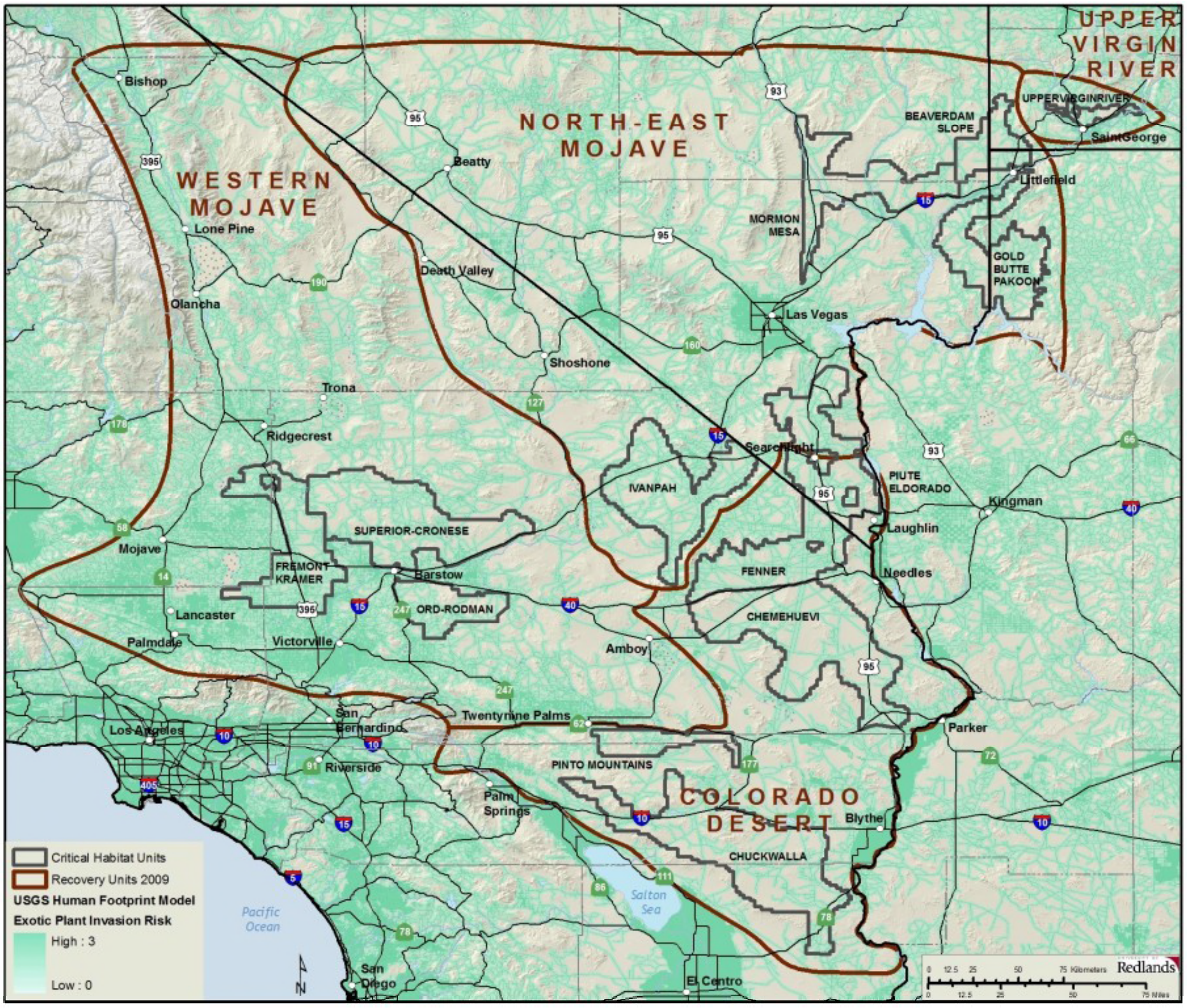
funding for the implementation of various actions that are intended to promote the recovery of the desert tortoise. Although most of these mitigation measures are consistent with recommendations in the recovery plans for the desert tortoise and the Service continues to support their implementation, we cannot assess how desert tortoise populations will respond because of the long generation time of the species.

In addition to the biological opinions issued for solar development within the range of the desert tortoise, the Service (2012e) also issued a biological opinion to the Department of the Army for the use of additional training lands at Fort Irwin. As part of this proposed action, the Army removed approximately 650 desert tortoises from 18,197 acres of the southern area of Fort Irwin, which had been off-limits to training. The Army would also use an additional 48,629 acres that lie east of the former boundaries of Fort Irwin; much of this parcel is either too mountainous or too rocky and low in elevation to support numerous desert tortoises.

The Service also issued a biological opinion to the Marine Corps that considered the effects of the expansion of the Marine Corps Air Ground Combat Center at Twentynine Palms (Service 2012f). We concluded that the Marine Corps' proposed action, the use of approximately 167,971 acres for training, was not likely to jeopardize the continued existence of the desert tortoise. Most of the expansion area lies within the Johnson Valley Off-high Vehicle Management Area.

The incremental effect of the larger actions (i.e., solar development, the expansions of Fort Irwin, and the Marine Corps Air Ground Combat Center) on the desert tortoise is unlikely to be positive, despite the numerous conservation measures that have been (or will be) implemented as part of the actions. The acquisition of private lands as mitigation for most of these actions increases the level of protection afforded these lands; however, these acquisitions do not create new habitat and Federal, State, and privately managed lands remain subject to most of the threats and stresses we discussed previously in this section. Although land managers have been implementing measures to manage these threats, we have been unable, to date, to determine whether the measures have been successful, at least in part because of the low reproductive capacity of the desert tortoise. Therefore, the conversion of habitat into areas that are unsuitable for this species continues the trend of constricting the desert tortoise into a smaller portion of its range.

As the Service notes in the 5-year review (Service 2010b), "(t)he threats identified in the original listing rule continue to affect the (desert tortoise) today, with invasive species, wildfire, and renewable energy development coming to the forefront as important factors in habitat loss and conversion. The vast majority of threats to the desert tortoise or its habitat are associated with human land uses." Oftedal's work (2002 in Service 2010b) suggests that invasive weeds may adversely affect the physiological health of desert tortoises. Current information indicates that invasive species likely affect a large portion of the desert tortoise's range (see following map). Furthermore, high densities of weedy species increase the likelihood of wildfires; wildfires, in turn, destroy native species and further the spread of invasive weeds.



Global climate change is likely to affect the prospects for the long-term conservation of the desert tortoise. For example, predictions for climate change within the range of the desert tortoise suggest more frequent and/or prolonged droughts with an increase of the annual mean temperature by 3.5 to 4.0 degrees Celsius. The greatest increases will likely occur in summer (June-July-August mean increase of as much as 5 degrees Celsius [Christensen et al. 2007 in Service 2010b]). Precipitation will likely decrease by 5 to 15 percent annually in the region with winter precipitation decreasing by up to 20 percent and summer precipitation increasing by up to 5 percent. Because germination of the desert tortoise's food plants is highly dependent on cool-season rains, the forage base could be reduced due to increasing temperatures and decreasing precipitation in winter. Although drought occurs routinely in the Mojave Desert, extended periods of drought have the potential to affect desert tortoises and their habitats through physiological effects to individuals (i.e., stress) and limited forage availability. To place the consequences of long-term drought in perspective, Longshore et al. (2003) demonstrated that even short-term drought could result in elevated levels of mortality of desert tortoises. Therefore, long-term drought is likely to have even greater effects, particularly given that the current fragmented nature of desert tortoise habitat (e.g., urban and agricultural development, Lakes allotments, which are located within critical habitat in the Western Mojave Recovery Unit;

current fragmented nature of desert tortoise habitat (e.g., urban and agricultural development, highways, freeways, military training areas, etc.) will make recolonization of extirpated areas difficult, if not impossible.

The Service notes in the 5-year review that the combination of the desert tortoise's late breeding age and a low reproductive rate challenges our ability to achieve recovery. When determining whether a proposed action is likely to jeopardize the continued existence of a species, we are required to consider whether the action would "reasonably be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 Code of Federal Regulations 402.02). Although the Service does not explicitly address these metrics in the 5-year review, we have used the information in that document to summarize the status of the desert tortoise with respect to its reproduction, numbers, and distribution.

In the 5-year review, the Service notes that desert tortoises increase their reproduction in high rainfall years; more rain provides desert tortoises with more high quality food (i.e., plants that are higher in water and protein), which, in turn, allows them to lay more eggs. Conversely, the physiological stress associated with foraging on food plants with insufficient water and nitrogen may leave desert tortoises vulnerable to disease (Oftedal 2002 in Service 2010b), and the reproductive rate of diseased desert tortoises is likely lower than that of healthy animals. Young desert tortoises also rely upon high-quality, low-fiber plants (e.g., native forbs) with nutrient levels not found in the invasive weeds that have increased in abundance across its range (Oftedal et al. 2002; Tracy et al. 2004). Compromised nutrition of young desert tortoises likely represents an effective reduction in reproduction by reducing the number that reaches adulthood. Consequently, although we do not have quantitative data that show a direct relationship, the abundance of weedy species within the range of the desert tortoise has the potential to negatively affect the reproduction of desert tortoises and recruitment into the adult population.

Data from long-term study plots, which were first established in 1976, cannot be extrapolated to provide an estimate of the number of desert tortoises on a range-wide basis; historic densities in some parts of the desert exceeded 100 adults in a square mile (Desert Tortoise Recovery Office 2014). Using data from the long-term study plots, the Service (2010b) concluded that "appreciable declines at the local level in many areas, which coupled with other survey results, suggest that declines may have occurred more broadly." Other sources indicate that local declines are continuing to occur. For example, surveyors found "lots of dead [desert tortoises]" in the western expansion area of Fort Irwin (Western Mojave Recovery Unit) in 2008 (Fort Irwin Research Coordination Meeting 2008). After the onset of translocation, coyotes killed 105 desert tortoises in Fort Irwin's southern translocation area (Western Mojave Recovery Unit); other canids may have been responsible for some of these deaths. Other incidences of predation were recorded throughout the range of the desert tortoise during this time (Esque et al. 2010). Esque et al. (2010) hypothesized that this high rate of predation on desert tortoises was influenced by low population levels of typical prey for coyotes due to drought conditions in previous years. Recent surveys in the Ivanpah Valley (Eastern Mojave Recovery Unit) for a proposed solar facility detected 31 live desert tortoises and the carcasses of 25 individuals that

had been dead less than 4 years (Ironwood 2011); this ratio of carcasses to live individuals over such a short period of time may indicate an abnormally high rate of mortality for a long-lived animal. In summary, the number of desert tortoises range-wide likely decreased substantially from 1976 through 1990 (i.e., when long-term study plots were initiated through the time the desert tortoise was listed as threatened), although we cannot quantify the amount of this decrease. Additionally, more recent data collected from various sources throughout the range of the desert tortoise suggest that local declines continue to occur (e.g., Bureau et al. 2005, Esque et al. 2010).

The distribution of the desert tortoise has not changed substantially since the publication of the original recovery plan in 1994 (Service 2010b) in terms of the overall extent of its range. Prior to 1994, desert tortoises were extirpated from large areas within their distributional limits by urban and agricultural development (e.g., the cities of Barstow, Lancaster, Las Vegas, St. George, etc.; agricultural areas south of Edwards Air Force Base and east of Barstow), military training (e.g., Fort Irwin, Leach Lake Gunnery Range), and off-road vehicle use (e.g., portions of off-road management areas managed by the Bureau and unauthorized use in areas such as east of California City). Since 1994, urban development around Las Vegas has likely been the largest contributor to habitat loss throughout the range. Desert tortoises have been essentially removed from the 18,197-acre southern expansion area at Fort Irwin (Service 2012e).

The following table depicts acreages of habitat (as modeled by Nussear et al. 2009) within various regions of the desert tortoise's range and of impervious surfaces as of 2006 (Xian et al. 2009). Impervious surfaces include paved and developed areas and other disturbed areas that have zero probability of supporting desert tortoises.

Regions[1]	**Modeled Habitat (acres)**	**Impervious Surfaces within Modeled Habitat**	**Percent of Modeled Habitat that is now Impervious**
Western Mojave	7,582,092	1,864,214	25
Colorado Desert	4,948,900	494,981	10
Northeast Mojave	7,776,934	1,173,025	15
Upper Virgin River	232,320	80,853	35
Total	20,540,246	3,613,052	18

[1]The regions do not correspond to recovery unit boundaries; we used a more general separation of the range for this illustration.

In conclusion, we have used the 5-year review (Service 2010b), revised recovery plan (Service 2011a), and additional information that has become available since these publications to review the reproduction, numbers, and distribution of the desert tortoise. The reproductive capacity of the desert tortoise may be compromised to some degree by the abundance and distribution of invasive weeds across its range; the continued increase in human access across the desert likely continues to facilitate the spread of weeds and further affect the reproductive capacity of the

species. Prior to its listing, the number of desert tortoises likely declined range-wide, although we cannot quantify the extent of the decline; since the time of listing, data suggest that declines continue to occur throughout most of the range, although recent information suggests that densities may have increased slightly in the Northeastern Mojave Recovery Unit. The continued increase in human access across the desert continues to expose more desert tortoises to the potential of being killed by human activities. The distributional limits of the desert tortoise's range have not changed substantially since the issuance of the original recovery plan in 1994; however, desert tortoises have been extirpated from large areas within their range (e.g., Las Vegas, other desert cities). The species' low reproductive rate, the extended time required for young animals to reach breeding age, and the multitude of threats that continue to confront desert tortoises combine to render its recovery a substantial challenge.

Status of Critical Habitat of the Desert Tortoise

The Service designated critical habitat for the desert tortoise in portions of California, Nevada, Arizona, and Utah in a final rule published February 8, 1994 (59 Federal Register 5820). The Service designates critical habitat to identify the key biological and physical needs of the species and key areas for recovery and to focus conservation actions on those areas. Critical habitat is composed of specific geographic areas that contain the biological and physical features essential to the species' conservation and that may require special management considerations or protection. These features, which include space, food, water, nutrition, cover, shelter, reproductive sites, and special habitats, are called the primary constituent elements of critical habitat. The specific primary constituent elements of desert tortoise critical habitat are: sufficient space to support viable populations within each of the six recovery units and to provide for movement, dispersal, and gene flow; sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species; suitable substrates for burrowing, nesting, and overwintering; burrows, caliche caves, and other shelter sites; sufficient vegetation for shelter from temperature extremes and predators; and habitat protected from disturbance and human-caused mortality.

Critical habitat of the desert tortoise would not be able to fulfill its conservation role without each of the primary constituent elements being functional. As examples, having a sufficient amount of forage species is not sufficient if human-caused mortality is excessive; an area with sufficient space to support viable populations within each of the six recovery units and to provide for movement, dispersal, and gene flow would not support desert tortoises without adequate forage species.

The final rule for designation of critical habitat did not explicitly ascribe specific conservation roles or functions to the various critical habitat units. Rather, it refers to the strategy of establishing recovery units and desert wildlife management areas recommended by the recovery plan for the desert tortoise, which had been published as a draft at the time of the designation of critical habitat, to capture the "biotic and abiotic variability found in desert tortoise habitat" (59 Federal Register 5820, see page 5823). Specifically, we designated the critical habitat units to follow the direction provided by the draft recovery plan (Service 1993a) for the establishment of

desert wildlife management areas. The critical habitat units in aggregate are intended to protect the variability that occurs across the large range of the desert tortoise; the loss of any specific unit would compromise the ability of critical habitat as a whole to serve its intended function and conservation role.

Despite the fact that desert tortoises do not necessarily need to move between critical habitat units to complete their life histories, both the original and revised recovery plans highlight the importance of these critical habitat units and connectivity between them for the recovery of the species. Specifically, the revised recovery plan states that "aggressive management as generally recommended in the 1994 Recovery Plan needs to be applied within existing (desert) tortoise conservation areas (defined as critical habitat, among other areas being managed for the conservation of desert tortoises) or other important areas ... to ensure that populations remain distributed throughout the species' range .... (Desert tortoise) conservation areas capture the diversity of the Mojave population of the desert tortoise within each recovery unit, conserving the genetic breadth of the species, providing a margin of safety for the species to withstand catastrophic events, and providing potential opportunities for continued evolution and adaptive change .... Especially given uncertainties related to the effects of climate change on desert tortoise populations and distribution, we consider (desert) tortoise conservation areas to be the minimum baseline within which to focus our recovery efforts (pages 34 and 35, Service 2011a)."

The 12 critical habitat units range in area from 85 to 1,595 square miles. However, the optimal reserve size recommended to preserve viable desert tortoise populations was 1,000 square miles (Service 1994a); only 4 critical habitat units meet this threshold. Consequently, for some smaller critical habitat units, their future effectiveness in conserving the desert tortoise is largely dependent on the status of populations immediately adjacent to their boundaries or within intervening linkages that connect these smaller critical habitat units to other protected areas. Although the Service (1994a) recommended the identification of buffer zones and linkages for smaller desert tortoise conservation areas, land management agencies have generally not established such areas.

Population viability analyses indicate that reserves should contain from 10,000 to 20,000 adult desert tortoises to maximize estimated time to extinction (i.e., approximately 390 years, depending on rates of population change; Service 1994a). However, during the three most recent years of monitoring within the critical habitat units, only three (in 2009 and 2010) to five (in 2008) of the critical habitat units met this target (McLuckie et al. 2010; Service 2009, 2012a, 2012b). Some critical habitat units share boundaries and form contiguous blocks (e.g. Superior-Cronese and Fremont-Kramer Critical Habitat Units), and those blocks in California include combined estimated abundances of over 10,000 adult desert tortoises. These blocks are adjacent to smaller, more isolated units (e.g., Ord-Rodman Critical Habitat Unit) that are not currently connected to other protected habitat by preserved habitat linkages.

We did not designate the Desert Tortoise Natural Area and Joshua Tree National Park in California and the Desert National Wildlife Refuge in Nevada as critical habitat because they are "primarily managed as natural ecosystems" (59 Federal Register 5820, see page 5825) and

provide adequate protection to desert tortoises. Since the designation of critical habitat, Congress increased the size of Joshua Tree National Park and created the Mojave National Preserve. A portion of the expanded boundary of Joshua Tree National Park lies within critical habitat of the desert tortoise; portions of other critical habitat units lie within the boundaries of the Mojave National Preserve.

Within each critical habitat unit, both natural and anthropogenic factors affect the function of the primary constituent elements of critical habitat. As an example of a natural factor, in some specific areas within the boundaries of critical habitat, such as within and adjacent to dry lakes, some of the primary constituent elements are naturally absent because the substrate is extremely silty; desert tortoises do not normally reside in such areas. Comparing the acreage of desert tortoise habitat as depicted by Nussear et al.'s (2009) model to the gross acreage of the critical habitat units demonstrates quantitatively that the entire area within the boundaries of critical habitat likely does not support the primary constituent elements; see the following table. The acreage for modeled habitat is for the area in which the probability that desert tortoises are present is greater than 0.5. The acreages of modeled habitat are from Service (2012b); they do not include loss of habitat due to human-caused impacts. The difference between gross acreage and modeled habitat is 653,214 acres; that is, approximately 10 percent of the gross acreage of the designated critical habitat is not considered modeled habitat.

Critical Habitat Unit	**Gross Acreage**	**Modeled Habitat**
Superior-Cronese	766,900	724,967
Fremont-Kramer	518,000	501,095
Ord-Rodman	253,200	184,155
Pinto Mountain	171,700	144,056
Piute-Eldorado	970,600	930,008
Ivanpah Valley	632,400	510,711
Chuckwalla	1,020,600	809,319
Chemehuevi	937,400	914,505
Gold Butte-Pakoon	488,300	418,189
Mormon Mesa	427,900	407,041
Beaver Dam Slope	204,600	202,499
Upper Virgin River	54,600	46,441
Totals	6,446,200	5,792,986

Condition of the Primary Constituent Elements of Critical Habitat

Human activities can have obvious or more subtle effects on the primary constituent elements. The grading of an area and subsequent construction of a building removes the primary constituent elements of critical habitat; this action has an obvious effect on critical habitat. The revised recovery plan identifies human activities such as urbanization and the proliferation of roads and highways as threats to the desert tortoise and its habitat; these threats are examples of activities that have a clear effect on the primary constituent elements of critical habitat.

We have included the following paragraphs from the revised recovery plan for the desert tortoise (Service 2011a) to demonstrate that other anthropogenic factors affect the primary constituent elements of critical habitat in more subtle ways. All references are in the revised recovery plan (i.e., in Service 2011a); we have omitted some information from the revised recovery plan where the level of detail was unnecessary for the current discussion.

> Surface disturbance from [off-highway vehicle] activity can cause erosion and large amounts of dust to be discharged into the air. Recent studies on surface dust impacts on gas exchanges in Mojave Desert shrubs showed that plants encrusted by dust have reduced photosynthesis and decreased water-use efficiency, which may decrease primary production during seasons when photosynthesis occurs (Sharifi et al. 1997). Sharifi et al. (1997) also showed reduction in maximum leaf conductance, transpiration, and water-use efficiency due to dust. Leaf and stem temperatures were also shown to be higher in plants with leaf-surface dust. These effects may also impact desert annuals, an important food source for [desert] tortoises.
>
> [Off-highway vehicle] activity can also disturb fragile cyanobacterial-lichen soil crusts, a dominant source of nitrogen in desert ecosystems (Belnap 1996). Belnap (1996) showed that anthropogenic surface disturbances may have serious implications for nitrogen budgets in cold desert ecosystems, and this may also hold true for the hot deserts that [desert] tortoises occupy. Soil crusts also appear to be an important source of water for plants, as crusts were shown to have 53 percent greater volumetric water content than bare soils during the late fall when winter annuals are becoming established (DeFalco et al. 2001). DeFalco et al. (2001) found that non-native plant species comprised greater shoot biomass on crusted soils than native species, which demonstrates their ability to exploit available nutrient and water resources. Once the soil crusts are disturbed, non-native plants may colonize, become established, and out-compete native perennial and annual plant species (DeFalco et al. 2001, D'Antonio and Vitousek 1992). Invasion of non-native plants can affect the quality and quantity of plant foods available to desert tortoises. Increased presence of invasive plants can also contribute to increased fire frequency.
>
> Proliferation of invasive plants is increasing in the Mojave and Sonoran deserts and is recognized as a substantial threat to desert tortoise habitat. Many species of non-native plants from Europe and Asia have become common to abundant in some areas, particularly where disturbance has occurred and is ongoing. As non-native plant species become established, native perennial and annual plant species may decrease, diminish, or die out (D'Antonio and Vitousek 1992). Land managers and field scientists identified 116 species of non-native plants in the Mojave and Colorado deserts (Brooks and Esque 2002).
>
> Increased levels of atmospheric pollution and nitrogen deposition related to increased human presence and combustion of fossil fuels can cause increased levels of soil nitrogen, which in turn may result in significant changes in plant communities (Aber et

> al. 1989). Many of the non-native annual plant taxa in the Mojave region evolved in more fertile Mediterranean regions and benefit from increased levels of soil nitrogen, which gives them a competitive edge over native annuals. Studies at three sites within the central, southern, and western Mojave Desert indicated that increased levels of soil nitrogen can increase the dominance of non-native annual plants and promote the invasion of new species in desert regions. Furthermore, increased dominance by non-native annuals may decrease the diversity of native annual plants, and increased biomass of non-native annual grasses may increase fire frequency (Brooks 2003).

This summary from the revised recovery plan (Service 2011a) demonstrates how the effects of human activities on habitat of the desert tortoise are interconnected. In general, surface disturbance causes increased rates of erosion and generation of dust. Increased erosion alters additional habitat outside of the area directly affected by altering the nature of the substrate, removing shrubs, and possibly destroying burrows and other shelter sites. Increased dust affects photosynthesis in the plants that provide cover and forage to desert tortoises. Disturbed substrates and increased atmospheric nitrogen enhance the likelihood that invasive species will become established and outcompete native species; the proliferation of weedy species increases the risk of large-scale fires, which further move habitat conditions away from those that are favorable to desert tortoises.

The following paragraphs generally describe how the threats described in the revised recovery plan affect the primary constituent elements of critical habitat of the desert tortoise.

<u>Sufficient space to support viable populations within each of the six recovery units and to provide for movement, dispersal, and gene flow</u>.

In considering the following discussion, bear in mind the information provided previously in this biological opinion regarding the recommended and actual sizes of critical habitat units for the desert tortoise. The original recovery team based the recommended size of desert wildlife management areas on the amount of space required to maintain viable populations. (The recovery plan [Service 1994a] defined conservation areas for the desert tortoise as 'desert wildlife management areas;' we based the boundaries of critical habitat on the recovery team's general recommendation for the desert wildlife management areas.) The current low densities of desert tortoises within critical habitat units exacerbate the difficulties of effecting recovery within these areas.

Urban and agricultural development, concentrated use by off-road vehicles, and other activities of this nature completely remove habitat. Although we are aware of local areas within the boundaries of critical habitat that have been heavily disturbed, we do not know of any areas that have been disturbed to the intensity and extent that this primary constituent element has been compromised. To date, the largest single loss of critical habitat is the use of 18,197 acres of additional training land in the southern portion of Fort Irwin. In our biological opinion for that proposed action (Service 2012e), we stated:

> The proposed action would essentially eliminate the primary constituent elements from approximately 2.40 percent of the Superior-Cronese Critical Habitat Unit; additionally, the conservation role of the remainder of this critical habitat unit and the other critical habitat units has been compromised by substantial human impact on the second and sixth primary constituent elements. However, the protective measures that the Army implemented as part of the proposed action offset, at least to some extent, the adverse effects of the use of the additional training lands in the southern expansion area. Consequently, we have concluded that, although the second and sixth primary constituent elements are not functioning appropriately throughout most of designated critical habitat of the desert tortoise and the proposed action would result in substantial disturbance to 18,197 acres of the Superior-Cronese Critical Habitat Unit, the change in the condition of critical habitat brought about by the Army's proposed action (i.e., use of the southern expansion area for training and implementation of the conservation actions) is not likely to cause an overall decrease in the conservation value and function of the Superior-Cronese Critical Habitat Unit.

The widening of existing freeways likely caused the second largest loss of critical habitat. Despite these losses of critical habitat, which occur in a linear manner, the critical habitat units continue to support sufficient space to support viable populations within each of the six recovery units.

In some cases, major roads likely disrupt the movement, dispersal, and gene flow of desert tortoises. Highways 58 and 395 in the Fremont-Kramer Critical Habitat Unit and Fort Irwin Road in the Superior-Cronese Critical Habitat Unit are examples of large and heavily travelled roads that likely disrupt movement, dispersal, and gene flow. Roads that have been fenced and provided with underpasses may alleviate this fragmentation to some degree; however, such facilities have not been in place for sufficient time to determine whether they will eliminate fragmentation.

The threats of invasive plant species described in the revised recovery plan generally do not result in the removal of this primary constituent element because they do not convert habitat into impervious surfaces, as would urban development.

<u>Sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species</u>.

This primary constituent element addresses the ability of critical habitat to provide adequate nutrition to desert tortoises. As described in the revised recovery plan and 5-year review, grazing, historical fire, invasive plants, altered hydrology, drought, wildfire potential, fugitive dust, and climate change/temperature extremes contribute to the stress of "nutritional compromise." Paved and unpaved roads through critical habitat of the desert tortoise provide avenues by which invasive native species disperse; these legal routes also provide the means by which unauthorized use occurs over large areas of critical habitat. Nitrogen deposition from atmospheric pollution likely occurs throughout all the critical habitat units and exacerbates the

effects of the disturbance of substrates. Because paved and unpaved roads are so widespread through critical habitat, this threat has compromised the conservation value and function of critical habitat throughout the range of the desert tortoise, to some degree. See the Status of the Desert Tortoise section of this biological opinion for a map that depicts the routes by which invasive weeds have access to critical habitat; the routes shown on the map are a subset of the actual number of routes that actually cross critical habitat of the desert tortoise.

Suitable substrates for burrowing, nesting, and overwintering.

Surface disturbance, motor vehicles traveling off route, use of OHV management areas, OHV events, unpaved roads, grazing, historical fire, wildfire potential, altered hydrology, and climate change leading to shifts in habitat composition and location, storms, and flooding can alter substrates to the extent that they are no longer suitable for burrowing, nesting, and overwintering. Erosion caused by these activities can alter washes to the extent that desert tortoise burrows placed along the edge of a wash, which is a preferred location for burrows, could be destroyed. We expect that the area within critical habitat that is affected by off-road vehicle use to the extent that substrates are no longer suitable is relatively small in relation to the area that desert tortoises have available for burrowing, nesting, and overwintering; consequently, off-road vehicle use has not had a substantial effect on this primary constituent element.

Most livestock allotments have been eliminated from within the boundaries of critical habitat. Of those that remain, livestock would compact substrates to the extent that they would become unsuitable for burrowing, nesting, and overwintering only in areas of concentrated use, such as around watering areas and corrals. Because livestock grazing occurs over a relatively small portion of critical habitat and the substrates in most areas within livestock allotments would not be substantially affected, suitable substrates for burrowing, nesting, and overwintering remain throughout most of the critical habitat units.

Burrows, caliche caves, and other shelter sites.

Human-caused effects to burrows, caliche caves, and other shelter sites likely occur at a similar rate as effects to substrates for burrowing, nesting, and overwintering for the same general reasons. Consequently, sufficient burrows, caliche caves, and other shelter sites remain throughout most of the critical habitat units.

Sufficient vegetation for shelter from temperature extremes and predators.

In general, sufficient vegetation for shelter from temperature extremes and predators remains throughout critical habitat. In areas where large fires have occurred in critical habitat, many of the shrubs that provide shelter from temperature extremes and predators have been destroyed; in such areas, cover sites may be a limiting factor. The proliferation of invasive plants poses a threat to shrub cover throughout critical habitat as the potential for larger and more frequent wildfires increases.

In 2005, wildfires in Nevada, Utah, and Arizona burned extensive areas of critical habitat (Service 2010b). Although different agencies report slightly different acreages, the following table provides an indication of the scale of the fires.

Critical Habitat Unit	**Total Area Burned (acres)**	**Percent of the Critical Habitat Unit Burned**
Beaver Dam Slope	53,528	26
Gold-Butte Pakoon	65,339	13
Mormon Mesa	12,952	3
Upper Virgin River	10,557	19

The revised recovery plan notes that the fires caused statistically significant losses of perennial plant cover, although patches of unburned shrubs remained. Given the patchiness with which the primary constituent elements of critical habitat are distributed across the critical habitat units and the varying intensity of the wildfires, we cannot quantify precisely the extent to which these fires disrupted the function and value of the critical habitat.

<u>Habitat protected from disturbance and human-caused mortality</u>.

In general, the Federal agencies that manage lands within the boundaries of critical habitat have adopted land management plans that include implementation of some or all of the recommendations contained in the original recovery plan for the desert tortoise. (See pages 70 to 72 of Service 2010b.) To at least some degree, the adoption of these plans has resulted in the implementation of management actions that are likely to reduce the disturbance and human-caused mortality of desert tortoises. For example, these plans resulted in the designation of open routes of travel and the closure (and, in some cases, physical closure) of unauthorized routes. Numerous livestock allotments have been relinquished by the permittees and cattle no longer graze these allotments. Because of these planning efforts, the Bureau's record of decision included direction to withdraw some areas of critical habitat from mineral entry. Because of actions on the part of various agencies, many miles of highways and other paved roads have been fenced to prevent desert tortoises from wandering into traffic and being killed. The Service and other agencies of the Desert Managers Group in California are implementing a plan to remove common ravens that prey on desert tortoises and to undertake other actions that would reduce subsidies (i.e., food, water, sites for nesting, roosting, and perching, etc.) that facilitate their abundance in the California desert (Service 2008).

Despite the implementation of these actions, disturbance and human-caused mortality continue to occur in many areas of critical habitat (which overlap the desert wildlife management areas for the most part and are the management units for which most data are collected) to the extent that the conservation value and function of critical habitat is, to some degree, compromised. For example, many highways and other paved roads in California remain unfenced. Twelve desert tortoises were reported to be killed on paved roads from within Mojave National Preserve in 2011, and we fully expect that desert tortoises are being killed at similar rates on many other roads, although these occurrences are not discovered and reported as diligently as by the

National Park Service. Employees of the Southern California Gas Company reported two desert tortoises in 2011 that were crushed by vehicles on unpaved roads.

Unauthorized off-road vehicle use continues to disturb habitat and result in loss of vegetation within the boundaries of critical habitat (e.g., Coolgardie Mesa in the Western Mojave Recovery Unit); although we have not documented the death of desert tortoises as a direct result of this activity, it likely occurs. Additionally, the habitat disturbance caused by this unauthorized activity exacerbates the spread of invasive plants, which displace native plants that are important forage for the desert tortoise, thereby increasing the physiological stress faced by desert tortoises.

Although the Bureau has approved, through its land use planning processes, the withdrawal of areas of critical habitat from mineral entry, it has not undertaken the administrative procedures to complete withdrawals in all areas. Absent this withdrawal, new mining claims can be filed and further disturbance of critical habitat could occur.

Finally, the Bureau has not allowed the development of solar power plants on public lands within the boundaries of its desert wildlife management areas (which largely correspond to the boundaries of critical habitat). Conversely, the County of San Bernardino is considering the approval of the construction and operation of at least two such facilities within the boundaries of the Superior-Cronese Critical Habitat Unit north of Interstate 15 near the Minneola Road exit.

Summary of the Status of Critical Habitat of the Desert Tortoise

As noted in the revised recovery plan for the desert tortoise and 5-year review (Service 2011a, 2010b), critical habitat of the desert tortoise is subject to landscape level impacts in addition to the site-specific effects of individual human activities. On the landscape level, atmospheric pollution is increasing the level of nitrogen in desert substrates; the increased nitrogen exacerbates the spread of invasive plants, which outcompete the native plants necessary for desert tortoises to survive. As invasive plants increase in abundance, the threat of large wildfires increases; wildfires have the potential to convert the shrubland-native annual plant communities upon which desert tortoises depend to a community with fewer shrubs and more invasive plants. In such a community, shelter and forage would be more difficult for desert tortoises to find. Invasive plants have already compromised the conservation value and function of critical habitat to some degree with regard to the second primary constituent element (i.e., sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species). These effects likely extend to the entirety of critical habitat, given the numerous routes by which invasive plants can access critical habitat and the large spatial extent that is subject to nitrogen from atmospheric pollution. (See maps from previous sections of this biological opinion regarding the extent of the threat of invasive plants and the aggregate stress that multiple threats, including invasive plants, place on critical habitat.)

Critical habitat has been compromised to some degree with regard to the last primary constituent element (i.e., habitat protected from disturbance and human-caused mortality) as a result of the wide variety of human activities that continues to occur within its boundaries. These effects

result from the implementation of discrete human activities and are thus more site-specific in nature.

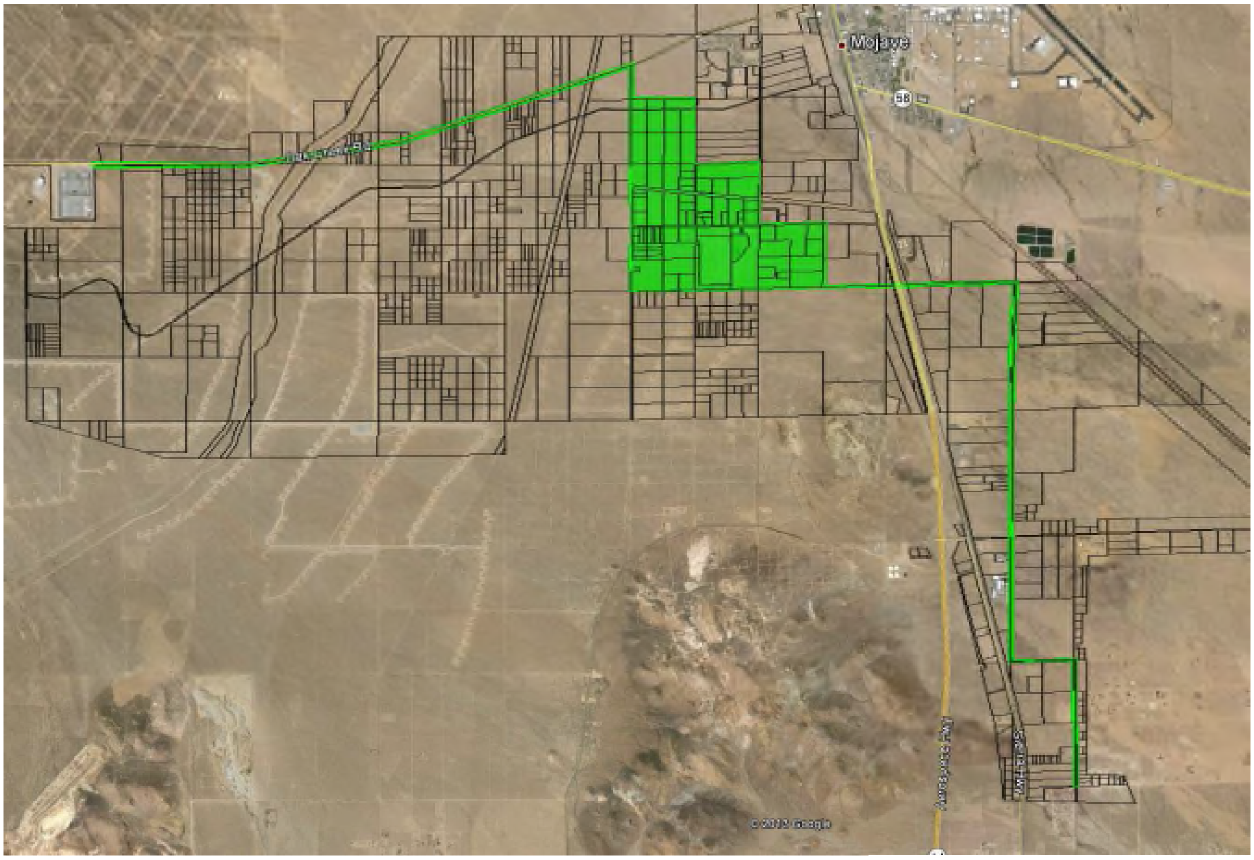
Although the remaining primary constituent elements have been affected to some degree by human activities, these impacts have not, to date, substantially compromised the conservation value and function of the critical habitat units. We have reached this conclusion primarily because the effects are localized and thus do not affect the conservation value and function of large areas of critical habitat.

Land managers have undertaken actions to improve the status of critical habitat. For example, as part of its efforts to offset the effects of the use of additional training maneuver lands at Fort Irwin (Service 2004), the Army acquired the private interests in the Harper Lake and Cronese Lakes allotments, which are located within critical habitat in the Western Mojave Recovery Unit; as a result, cattle have been removed from these allotments. Livestock have been removed from numerous other allotments through various means throughout the range of the desert tortoise. The retirement of allotments assists in the recovery of the species by eliminating disturbance to the primary constituent elements of critical habitat by cattle and range improvements.

ENVIRONMENTAL BASELINE

Action Area

The implementing regulations for section 7(a)(2) of the Act define the "action area" as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 Code of Federal Regulations 402.02). The action area for this biological opinion is the footprint of Edwards Air Force Base, which consists of 307,516 acres, and the route of the gen-tie line from the proposed Oro Verde Solar Project in the northwestern corner of the base to the Windhub Substation, as depicted on the following map (Brewer-Anderson 2013). The precise route for the gen-tie line has not been finalized. The easement for the gen tie line would be 13.9 miles long and up to 110 feet wide. The easement would cover approximately 147 acres.



Habitat Characteristics of the Action Area

The following information provides a summary of the discussion of habitat characteristics from the biological evaluation (Air Force 2008a) and integrated natural resources management plan (Air Force 2008b). The proposed action area is located in the western portion of the Mojave Desert mid-way between the southern end of the Sierra Nevada and the San Bernardino Mountains. Edwards Air Force Base is visually dominated by three dry lakebeds: Rosamond, Rogers, and Buckhorn dry lakes. The area is characterized as high desert with broad expansive valleys bordered by low rocky hills.

The main plant communities on base include creosote bush scrub, saltbush scrub, Joshua tree woodland, and mesquite woodland. The zonal plant communities are primarily based on soil characteristics and elevation; elevation ranges on the base range between 2,500 to 3,300 feet, and topography gradually slopes from west to east. Vegetation in the upland areas on base consists of two main plant communities: creosote bush scrub and Joshua tree woodland. Lowland communities consist of the alkali sink and saltbush communities.

Existing Conditions in the Action Area

In this section, we discuss the anthropogenic and natural conditions in the action area as they relate to desert tortoises and their habitat. Unless we have noted otherwise by citing a biological opinion, the anthropogenic conditions present in the action area were constructed or instituted prior to the listing of the desert tortoise. We summarized the following information from the biological evaluation (Air Force 2008a), integrated natural resources management plan (Air Force 2008b), and communications with Edwards Air Force Base personnel.

Land Use

Edwards Air Force Base is divided into 7 environmental management areas or support zones to better manage the variety of environmental management programs. Figure 3-2 in the integrated natural resource management plan depicts the boundaries of each support zone.

The first zone is a relatively isolated developed area which contains the Air Force Research Laboratory. This area is surrounded by the Precision Impact Range Area in the northeastern portion of the base; desert tortoises are occasionally encountered in this zone.

The second and third zones are composed of main base south and main base north, respectively. Main base south supports areas developed for residential, recreational and commercial use. Main base north is the third zone and supports developed and undeveloped areas; developments in this area support a wide range of operations conducted by the base. Environmental issues in this zone include off-road vehicle areas and the presence of desert tortoise populations.

Zones four and five were developed to support flightline activities. The fourth zone, which is south base, is the original flightline that now primarily functions as a taxiway. Zone five contains the flightline, taxiways and associated hangars. Environmental issues of concern while operating in zone five include desert tortoise and habitat recovery.

The sixth environmental zone consists of the north base and Precision Impact Range Areas. The Precision Impact Range Area covers a large portion of the eastern part of the base and supports low-level aircraft flight-testing, open burn/open detonation facility, and various other facilities; this area also contains desert tortoise critical habitat. The Service (1994b) issued a biological opinion regarding the effects of establishing the Precision Impact Range Area on the desert tortoise and its critical habitat; in this biological opinion, we concluded that the proposed action was not likely to jeopardize the continued existence of the desert tortoise or destroy or adversely modify its critical habitat because of implementation of numerous measures intended to minimize the effects of the proposed action on desert tortoises. The open burn/open detonation area on the Precision Impact Range Area is equipped with desert tortoise exclusion fencing to prevent individuals from entering the facility; due to regular grading, very little vegetation persists within or immediately adjacent to the fenced area of the open burn-open detonation unit. Zone seven comprises undeveloped lands used for a wide variety of base activities including, but not limited to buffer zone around the three lakebeds, aircraft drop zones, shooting ranges,

training area, and lakebed runways. Environmental issues in this management area include desert tortoise, water wells, unpaved roads and emergency landing areas.

The Service has issued biological opinions regarding the effects of establishing, operating, and maintaining a suite of facilities and training areas throughout Edwards Air Force Base on the desert tortoise and its critical habitat. Desert tortoises have been translocated from the areas as necessary to successfully carry out the proposed actions and minimize impacts to desert tortoise. We concluded that the proposed actions were not likely to jeopardize the continued existence of the desert tortoise or destroy or adversely modify its critical habitat; we expect that these actions led to an overall decrease in the number of individuals in these areas.

The type and frequency of use varies greatly between areas. Some areas are heavily used and others remain virtually untouched (Air Force 2008b). Large areas of the base remain undeveloped and accommodate testing activities. A perimeter fence was installed around the base to help conserve desert tortoise habitat, in particular critical habitat. Areas designated as desert tortoise critical habitat require personnel to follow different levels of protection measures based upon the activities planned within that area.

The Air Force has re-vegetated areas disturbed by wildfire burns, unused vehicle routes, abandoned targets, closed borrow pits, closed landfills, and other areas within desert tortoise habitat. As of May 2013, the base has re-vegetated approximately 135 acres of habitat (much of which took place in previously burned areas) (Air Force 2014a). Of this amount, approximately 55 acres are located in critical habitat on the Precision Impact Range Area.

Impacts to natural resources may result in the release of hazardous substances, pollutants, and contaminants into the environment from mission-related activities. The Service issued five biological opinions regarding the effect of the Installation Restoration Program on desert tortoises and its critical habitat; in the biological opinions, we concluded that the proposed actions were not likely to jeopardize the continued existence of the desert tortoise or destroy or adversely modify its critical habitat because a reduction in disturbance is likely to benefit desert tortoises by reducing the amount of habitat that is lost or degraded.

The area between the northwest corner of the base and the Windhub Substation generally supports desert habitat with some scattered residences and businesses. The western end of the gen-tie line crosses through areas that have been developed as wind farms.

Use by Feral and Domestic Livestock

One of the primary historic uses of the land within Edwards Air Force Base included livestock grazing. Although livestock grazing has not legally occurred on base since 1950, portions are still recovering from past overgrazing practices. Illegal sheep grazing occasionally occurred along the northern boundary of the base; installation of boundary fence along the base perimeter has eliminated this problem. Sheep grazing still occurs around the base periphery resulting in some edge effects. Sheep likely occasionally graze in areas along the route of the proposed gen-tie line.

Non-native Species

The processes of grazing, urbanization, agriculture, and road and utility construction have resulted in the introduction of invasive annuals to the native flora, particularly split grass (*Schismus barbatus*), cheat grass (*Bromus tectorum*), and red brome (*Bromus madritensis* ssp. *rubens*). More recently, Sahara mustard (*Brassica tournfortii*) has spread into the western Mojave Desert from the Colorado Desert; it has been observed along U.S. Highway 395 along the edge of the eastern boundary of the base. We expect the abundance of these species to be higher in portions of the base that experienced the most recent livestock grazing.

The abundance and diversity of non-native species in any area vary in relation to the seasonal weather; consequently, the composition of the non-native plant flora may be substantially different from year to year. An overabundance of weedy species likely compromises the nutritional status of desert tortoises, as we discussed in the Status of the Species section of this biological opinion. We do not have specific information on the distribution of non-native species nor on their specific effects on desert tortoises in the action area.

Paved and Unpaved Roads

Highway 395 traverses the northeast corner of Edwards Air Force Base. State Route 58 parallels the northern boundary, with the exception of a small portion that crosses into the base. The construction of Highway 395 and State Route 58 resulted in the loss of viable desert tortoise habitat and poses as a barrier to movement of desert tortoises; we anticipate that at least a few desert tortoises are killed on these roads annually. State Highway 14 crosses the proposed route of the gen-tie line at about its midpoint. Furthermore, we expect that desert tortoise densities adjacent to these major roads are depressed, as discussed by Hoff and Marlow (2002), but we are not aware of surveys that quantify this effect in these specific areas.

The paved roads within the base are focused in areas supporting development and urbanization. The Service (1993b) issued a biological opinion that concluded that the proposed maintenance and repair of roads throughout the base was not likely to jeopardize the continued existence of the desert tortoise or destroy or adversely modify its critical habitat because most of the proposed actions would occur in previously disturbed areas.

In addition to the paved roads within the base, unpaved roads also traverse the action area. One of the primary historic uses of the land within Edwards Air Force Base included off-road and off-highway vehicle activities. Currently, off-road driving is generally prohibited except for within three designated off-road vehicle areas on base (see figure 7-8 in Air Force 2008b). Off-road vehicle area 1 is approximately 100 acres and designated only for use by the Desert Wheels Motorcycle Club. Off-road vehicle area 2 is approximately 15,040 acres located west of military family housing and is jointly used for off-road vehicles, equestrians, and general recreation. Off-road vehicle area 3 is approximately 4,328 acres, including 32 miles of trails, and is only used for non-motorized mountain biking and jogging. No motorized off-road vehicles are permitted in this area. The Service (1996) issued a biological opinion to the Air Force that considered the

effects of establishment and continued use of off-road vehicle area 2 on the desert tortoise. We concluded that the proposed action was not likely to jeopardize the continued existence of the desert tortoise. We expect that recreational use of these areas likely results in the death or injury of desert tortoises.

In July 2002, the Air Force (2008a) had installed approximately 42 miles of desert tortoise exclusion fencing throughout the base. The Air Force fenced roads to reduce injury and mortality to desert tortoises associated with their use. However, the Air Force subsequently determined that the increased fragmentation of habitat and barriers to movement could outweigh the benefit of reducing the injury and mortality of desert tortoises. Edwards Air Force Base currently has approximately 13 miles of desert tortoise exclusion fencing along areas where desert tortoises and threats overlap (Mull 2013b). The Air Force continues to evaluate the need for desert tortoise barrier fencing along roads to maintain connectivity of adjacent habitat.

Since the listing of the desert tortoise, five known desert tortoise deaths have occurred on Edwards Air Force Base; most of the deaths resulted from desert tortoises getting run over by mission-related traffic (Mull 2013c, 2013d). Environmental Management has closed rarely used dirt roads on portions of the base by constructing barriers across those roads; more road closures are planned in the future. New road construction is limited on base. Edwards Air Force Base personnel are encouraged to use existing roads for access throughout the base whenever possible. New roads were created in the past for projects; however, for many years, new projects have been designed to use existing roads as much as possible.

Utilities

Several underground utilities have been constructed in the northern border of the base paralleling State Highway 58. The Service (1995) issued a biological opinion to the Air Force that considered the effects of installing underground communication lines and related facilities at Edwards Air Force Base. We concluded that the proposed action was not likely to jeopardize the continued existence of the desert tortoise.

Large utility poles occur along the eastern boundary paralleling Highway 395. Utility construction on the base from the south and west has also occurred along well-traveled roads. These utilities were installed in the road shoulder or beneath paved or unpaved roads, which presents no new ground disturbance to the habitat adjacent to the road.

The most substantial ongoing effect of utility poles is their ongoing use by common ravens for perching and nesting. The presence of this additional nesting substrate, which allows common ravens to nest far above the reach of ground-dwelling predators, likely contributes substantially to the increase in the number of common ravens in the desert. As previously discussed, common ravens prey on desert tortoises and are likely detrimental to the recovery of the desert tortoise. The need for road maintenance on the utility corridors has left permanent bare areas. Roads along and above utility corridors are occasionally used for maintenance. As we previously

mentioned, the Air Force participates in ongoing re-vegetation efforts which aide in reducing impacts from the establishment of utility corridors.

Status of the Desert Tortoise in the Action Area

The Air Force conducted four major surveys throughout the base between 1991 and 1994 to determine relative density estimates of the desert tortoise. With some exceptions, results of these surveys indicate desert tortoises occur throughout the base, but are not uniformly distributed. Approximately 126 square miles (27 percent) of the base were excluded due to lack of desert tortoise habitat (e.g., dry lake beds, cantonment areas, research facilities, graded targets, housing areas, and other operational areas). The Air Force repeated these density surveys from 2006 through 2007 following the same methodology employed during the 1991 to 1994 surveys.

The Air Force used the total corrected sign method to conduct these surveys. In this methodology, surveyors record the amount of desert tortoise sign (e.g., scat, barrows, etc.) observed while walking transects and then develop a density estimate by calibrating the results against densities on long-term study plots, where the density of desert tortoises had been previously estimated using mark-recapture studies. This technique provides an index of relative density only and is no longer used for several reasons.

The following table summarizes results of surveys conducted from 1991 to 1994 and from 2006 to 2007 (Air Force 2008b, Air Force 2010). Although the absolute numbers may be questionable, the comparison of average densities between the two survey periods seems to indicate that the number of desert tortoises on Edwards Air Force Base has declined.

Survey Period	**Density range (individuals per square mile)**	**Average density (individuals per square mile)**
1991-1994	3 to 69	15.9
2006-2007	0 to 58	7.8

Results of the 2006 to 2007 surveys indicate that the relative density of desert tortoises are approximately twice as high near designated critical habitat and within the eastern portion of the base as they are on the west side. The mean relative density of desert tortoises on the east side of the base was 10.3 per square mile; on the west side, the mean relative density was 5.1 desert tortoises per square mile. Fewer desert tortoises are observed along the lakebeds and in the southwestern portions of the base. We added the densities of the areas surveyed and estimated that approximately 2,643 desert tortoises occurred on Edwards Air Force Base at the time of the 2006 and 2007 surveys; because of the variability associated with this methodology, we emphasize that this number represents a very rough estimate.

As we discussed in the Existing Conditions in the Action Area section, we expect that State Routes 58, which borders a portion of the northern edge of the base, and 395, which crosses its

northeastern tip, have likely resulted in a decrease in the numbers of desert tortoises adjacent to these roads. The number of desert tortoises on base has also likely been affected to a degree by the extensive human activity at Edwards Air Force Base that occurred prior to the listing of the species in 1989 (e.g., development of the main base, housing areas, bombing ranges and training areas, etc.; see Appendix B in Air Force 2008a). Finally, desert tortoises on base likely experienced an overall decrease in density as a result of the same factors that affected desert tortoises throughout the western Mojave Desert as we discussed in the Status of the Species section of this biological opinion.

The following table depicts the numbers of desert tortoises that have been killed or moved from harm's way as a result of the Air Force's activities under its active biological opinions (Mull 2013d). As in every action that covers a large area, we expect that the Air Force did not detect all injuries and mortalities. Because the number of desert tortoise mortalities is lower than the number moved from harm's way and substantially lower than the number of observations, we expect that the Air Force's protective measures are generally functioning well and that few animals have been killed or injured as a result of the activities.

Biological opinion	**Total number of Desert Tortoises**		
	Observed	**Mortalities**	**Moved from harm's way**
1-6-91-F-28	3	1	1
1-6-92-F-61	1	0	3
1-8-93-F-5	9	0	2
1-8-93-F-18	0	0	0
1-8-93-F-23	18	0	1
1-8-93-F-32	1	0	1
1-8-93-F-35	0	0	0
1-8-94-F-6	68	2	16
1-8-94-F-19	6	0	0
1-8-94-F-25	0	0	0
1-8-95-F-1	0	0	0
1-8-95-F-6	0	0	0
1-8-95-F-31	1	0	0
1-8-96-F-10	2	0	1
1-8-96-F-45	11	0	0
1-8-96-F-56	0	0	0
1-8-97-F-10	73	2	40
1-8-97-F-38	3	0	0
1-8-98-F-21R	0	0	0
1-8-99-F-58	0	0	0
Total	196	5	65

Total number of desert tortoise observations, mortalities, and moved from harm's way under biological opinions for Edwards Air Force Base from January 1, 1997 to May 31, 2013.

The Air Force is unlikely to find every desert tortoise that dies as a result of its activities. Although we expect that the Air Force's activities have killed more than 5 desert tortoises since its listing, we also expect that the overall number of animals that have died is unlikely to be substantially more than that observed by the Air Force. We have reached this conclusion because the generally low density of desert tortoises on base likely decreases the frequency of interactions between the Air Force's activities and desert tortoises. Additionally, the intensity of monitoring employed by the Air Force and the general high level of awareness of desert tortoises by base personnel in general likely add further protection to individuals of this species.

We expect that desert tortoises occur along the proposed easement for the gen-tie line in low numbers; we are aware of a few desert tortoises that have been detected in the area of the wind farms as a result of surveys conducted in that area. Sheep grazing and unauthorized off-road vehicle use have likely degraded the quality of habitat in this area and resulted in the deaths of desert tortoises. Because of the human activity associated with the residences and businesses, we expect that common ravens are common in this area and exert heavy predation pressure on desert tortoises. We also expect that the presence of State Route 14 has caused a local depression in the number of desert tortoises along the easement.

Status of Critical Habitat of the Desert Tortoise in the Action Area

Approximately 65,554 acres of the Fremont-Kramer Critical Habitat Unit are generally located on the south central and eastern portions of Edwards Air Force Base (Air Force 2008b); this area includes portions of Air Force research facilities and the Precision Impact Range Area. (See figure 5-7 in Air Force 2008b). The Air Force did not provide information on the overall condition of the primary constituent elements of critical habitat within the boundaries of Edwards Air Force Base. In general, we expect that the condition of the primary constituent elements within the installation is similar to that within the remainder of the Fremont-Kramer Critical Habitat Unit. That is, although we expect that the first, third, fourth, and fifth primary constituent elements have been affected to some degree by the Air Force's activities, these impacts have not, to date, substantially compromised the conservation value and function of the critical habitat. We expect that invasive plants have compromised the conservation value and function of critical habitat to some degree with regard to the second primary constituent element (i.e., sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species). Because most of the critical habitat within Edwards Air Force Base experiences fewer disturbances than public lands off base, we expect that the sixth primary constituent element (i.e., habitat protected from disturbance and human caused mortality) has not been appreciably affected by human activities.

The Air Force's activities contribute to the less-than-prime condition of the second primary constituent element. As previously mentioned in the Environmental Baseline, desert tortoise critical habitat is present within the Precision Impact Range Area on base; this area is divided into three management zones that roughly correspond with mission use in each zone. Zone 1 is a designated 4,681-acre area that experiences the heaviest use within the Precision Impact Range Area and critical habitat. Approximately 27,902 acres of critical habitat fall within the area

designated as Zone 2, this area experiences a moderate level of activity that is expected to continue at its current rate. Zone 3 encompasses 31,254 acres of the Precision Impact Range Area. Very little activity occurs within this area. The remaining critical habitat on base that is not associated with the three management zones is 1,717 acres.

The following table shows the total acres of habitat disturbance and re-vegetation efforts in desert tortoise critical habitat under active biological opinions for Edwards Air Force Base. The total acres of disturbance and re-vegetation comprise approximately 0.16 and 0.09 percent of the amount of critical habitat that lies with the boundaries of Edwards Air Force Base, respectively. We adapted the table from Mull (2013d) to include only biological opinions in which habitat disturbance or re-vegetation efforts occurred in areas designated as critical habitat.

Biological opinion	**Total acres of desert tortoise critical habitat disturbed**		**Total acres of re-vegetation**
	Permanent	**Temporary**	
1-8-93-F-23	0.5846	1.59	0
1-8-94-F-6	12.452	79.036	55.45
1-8-94-F-19	0	1.77	0
Total	**13.0366**	**82.396**	**55.45**

Total acres of habitat disturbance and re-vegetation in desert tortoise critical habitat under biological opinions for Edwards Air Force Base from 1 January 1997 – 31 May 2013.

EFFECTS OF THE ACTION

As we described in the Description of the Proposed Action section of this biological opinion, the Air Force and Service evaluated each of the Air Force's proposed activities and listed the aspects of the activity that may affect desert tortoises or their habitat (including critical habitat). In this section of the analysis, we will provide a general description of how these various aspects affect desert tortoises and their habitat (including critical habitat).

After we review the general mechanisms of how the Air Force's activities may affect desert tortoises and their critical habitat, we will analyze the potential effects of the injury or death of up to 5 desert tortoises per year and the loss of up to 5,000 of critical habitat and 15,000 acres outside of critical habitat. The Air Force and Service developed these numbers as thresholds upon which to base the analysis of Future Development in this biological opinion and to provide a trigger for the re-initiation of formal consultation.

Desert tortoises less than 160 millimeters in length (including hatchlings and eggs) are difficult to detect. Surveyors are less likely to detect them than desert tortoises greater than 160 millimeters because hatchlings can take shelter in burrows of all sizes and are difficult to see due to their cryptic nature and their small size. Consequently, we expect that most hatchlings and eggs likely remain in work areas that have been cleared of larger desert tortoises. We anticipate that future activities are likely to result in injury or mortality of small (i.e., less than 160

millimeters in length) desert tortoises because they are more difficult to detect. Because of their cryptic nature and small size, these mortalities have potential to go undetected. We acknowledge that smaller desert tortoises and eggs may be killed during the implementation of the Air Force's activities; however, because they are difficult to detect and because larger individuals are more important for the long-term conservation of the species, we focused our analysis on larger individuals.

Driving Off Roads

Desert Tortoise

In general, the use of vehicles off of roads (paved or unpaved) can injure or kill desert tortoises; vehicles traveling off road can also crush desert tortoise burrows trapping individuals in their collapsed burrows. In contrast to recreational off-highway vehicle use, where numerous vehicles travel off road at high speeds and with little or no regard to natural resources, the Air Force's use of vehicles off road are prohibited under normal conditions, but limited off-road use may be required in emergencies or to support specific mission requirements. Because the off-road activities associated with range-ground operations and the expenditure of ordnance and energetic materials are expected to be infrequent and these activities would be controlled by the Air Force, we expect that use of vehicles off paved or unpaved roads is likely to injure or kill few desert tortoises.

Critical Habitat

In general, the use of vehicles off of roads (paved or unpaved) can destroy plants needed for cover and food, erode and compact substrates, cause proliferation of weeds, and increase in the number and location of wildfires. We do not expect that the use of vehicles off of roads, at the extent likely to be conducted by the Air Force, would have a measurable effect on the first primary constituent element of critical habitat (sufficient space to support viable populations within each of the six recovery units and to provide for movement, dispersal, and gene flow). We have reached this conclusion because the Air Force's use would be infrequent and monitored to the extent that it would not reduce the amount of habitat within critical habitat and prevent movement, dispersal, and gene flow.

The second through fifth primary constituent elements (sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species; suitable substrates for burrowing, nesting, and overwintering; burrows, caliche caves, and other shelter sites; sufficient vegetation for shelter from temperature extremes and predators) are related to the biological and physical aspects of critical habitat. We expect the low level of use of vehicles off roads, which will be appropriately monitored, would not affect the function of these aspects of the desert tortoise's habitat in a measurable manner.

This aspect of the Air Force's activities would minimally affect the sixth primary constituent element (habitat protected from disturbance and human caused mortality) because it would occur infrequently and be monitored.

Driving on Roads

Desert Tortoise

Desert tortoises are generally more easily observed on roads, because of their more even surfaces and lack of plant cover. Roads often allow vehicles to travel at higher speeds, which reduce the likelihood of drivers detecting and avoiding desert tortoises. Rises and turns in roads also decrease the ability of drivers to detect desert tortoises. Along heavily used roads, the number of desert tortoises is depressed for some distance from the edge of the road as a result of road-associated mortality; this distance varies with the level of use of the road. In general, vehicle use is likely to result in at least some mortalities of and injuries to desert tortoises; the extent of the loss is related to the condition of the road, the time of the year when vehicle use occurs, the abundance of desert tortoises, and the awareness of the driver. Even the most careful drivers may occasionally strike a desert tortoise.

To date, most of the reported desert tortoise mortalities that have occurred in the action area resulted from vehicles driving over them on roads during permitted activities (Mull 2013c). Additionally, personnel have moved many more from roadways. The Air Force addresses this threat in its protective measures by posting signs for reduced speed limits where appropriate. We expect this threat to persist throughout the action area.

Critical Habitat

The use of existing roads will not affect the second through fifth primary constituent elements because these physical and biological aspects of critical habitat are no longer present within roads. Roads that experience high levels of traffic can essentially form a barrier to movement, dispersal, and gene flow (first primary constituent element); we do not expect that any roads within Edwards Air Force Base within desert tortoise habitat experience this level of traffic. High levels of traffic may affect the sixth primary constituent element (habitat protected from disturbance and human caused mortality) by increasing the number of desert tortoises that are injured or killed; we do not anticipate that traffic levels in desert tortoise habitat would rise to such levels.

Ground Disturbance

Desert Tortoise

We consider ground disturbance to include any activity where the Air Force's activities disrupt vegetation and substrate through the use of heavy equipment and materials. Desert tortoises may be injured or killed or trapped in their burrows during these activities. Some of the Air Force's

activities may cause negligible amounts ground disturbance. Conversely, the construction of a new target or building may result in ground disturbance over a larger area.

Because the Air Force would use standard and successful measures and experienced staff to avoid injuring or killing desert tortoises during ground-disturbing activities, we expect that relatively few individuals are likely to be injured or killed as a result of ground disturbance.

Critical Habitat

Ground disturbance has the potential to adversely affect all the primary constituent elements of critical habitat. Small amounts of ground disturbance that are temporary in nature would generally affect critical habitat less than larger areas of permanent disturbance, although some indirect effects of smaller projects (e.g., the proliferation of weeds) can extend well beyond the temporal and spatial footprint of a project.

Explosions

Desert Tortoise

Ordnance or other materials associated with explosions could strike a desert tortoise directly. Additionally, unforeseen explosions such as an accidental crash of an unmanned aerial vehicle could also strike and injure or kill a desert tortoise. Such events are likely extremely rare, given the large area of the target sites, the sparse distribution of desert tortoises, and the relatively small area that the explosion would affect. Additionally, the Air Force's standard practice is to check areas within desert tortoise habitat before emergency scheduled explosions occur to remove any desert tortoises that may be present. Some potential exists that large explosions can cause over pressure vibrations that would cause nearby burrows to collapse and trap desert tortoises inside.

Desert tortoises may be injured by noise associated with explosions. Bowles et al. (1999) found that subsonic and supersonic aircraft noise did not elicit substantial responses from desert tortoises. If a desert tortoise were close to a large explosion, however, we expect that the noise would have the potential to cause physical damage to the animal. Because the Air Force inspects areas and would remove desert tortoises before explosions occur, few desert tortoises are likely to be injured or killed by explosions.

The Air Force's use of the target sites and open burn/open detonation facilities can reasonably be expected to start fires under the appropriate conditions. Therefore, we will consider these fires as a likely effect of explosions. Desert tortoises may be burned to death from fires started by weapons testing, open burn/open detonation activities in areas containing vegetation, lightning or aircraft crashes (Air Force 2008a). Fires can injure or kill desert tortoises that are away from their burrows; the use of fire equipment to fight fires could also kill desert tortoises. Larger fires during times of the year and day when desert tortoises are active are more likely to injure or kill desert tortoises than smaller fires when desert tortoises are inactive (i.e., in their burrows). Desert tortoises are less likely to be present in areas that have repeatedly burned, where non-

native grasses predominate; to the extent that at least some fires occur in such areas, the risk of desert tortoises being injured or killed by fire is somewhat reduced.
The Air Force's fire management measures are likely to reduce the potential for fires started at target sites. This measure is protective of desert tortoises because fires can kill desert tortoises that may be above ground.

Critical Habitat

The Air Force's use of explosives would not directly impair the value and function of critical habitat with regard to the first primary constituent element (sufficient space to support viable populations within each of the six recovery units and to provide for movement, dispersal, and gene flow). We have reached this conclusion because the explosions occur in relatively small areas that are used repeatedly. Most explosions would likely occur in areas that have been previously used for such work. However, if a large fire spread from target sites, the potential exists that habitat conditions could be altered to the extent that desert tortoises would no longer traverse such areas.

Large explosions would likely alter the quality and quantity of forage species and the soil conditions to provide for the growth of these species in new target areas (the second primary constituent element); target areas that have been used previously likely no longer support these features. Smaller explosions likely have little or no direct effect on this primary constituent element. As we previously discussed, fire spreading from a target area would likely reduce the value and function of this primary constituent element.

Large explosions likely damage substrates for burrowing, nesting, and overwintering (third primary constituent element) and burrows, caliche caves, and other shelter sites (fourth primary constituent element). Because most explosions would occur in previously used, defined target areas, damage to substrates and shelter sites is likely to be minimal. Fire may affect substrates and shelter sites if it removes sufficient plant cover to increase erosion during storm events. Large explosions would remove vegetation that desert tortoises use for shelter from temperature extremes and predators (the fifth primary constituent element), but generally in a limited area. This adverse effect would be reduced by the use of existing target sites. Fire would affect shelter sites provided by shrubs if it spreads beyond the disturbed target site.

The repeated use of target sites would reduce the potential for explosions to have a measurable effect on the sixth primary constituent element (habitat protected from disturbance and human-caused mortality) because the disturbance and potential for mortality of desert tortoises would be limited to a relatively small portion of critical habitat. Conversely, the creation of new bombing targets in critical habitat requires the Air Force to clear additional lands. As with the other primary constituent elements, fire that spreads beyond disturbed areas around the target sites would increase the adverse effect.

The Air Force's fire management measures likely reduce the potential that fires started at target sites would have a measurable effect on the primary constituent elements of critical habitat of the desert tortoise. One of the primary natural resources management goals of the base's integrated

natural resources management plan is to conserve natural resources in a manner consistent with the military mission and the base's wildland fire management plan by implementing effective suppression of wildland fires and minimizing fire and structural damage to biological resources (Air Force 2008b). Although Edwards Air Force Base has over 200,000 acres of unimproved vegetated terrain, the base has not had a history of a severe fire danger hazard over the past 25 years; lightning is the primary cause of fires on base (Air Force 2008b).

Non-native Plant Species

Desert Tortoise

Vehicles, ground disturbance, fire, and other human activities contribute to the dispersal of non-native plant species. These non-native plants include species that are already present in the California desert and newly introduced species. As we discussed in the Status of the Species and Critical Habitat section of this biological opinion, non-native plants can alter the quality and quantity of plant foods available to desert tortoises and thereby affect their nutritional intake.

Critical Habitat

The spread of non-native plant species may impair the value and function of the first primary constituent element (sufficient space to support viable populations within each of the six recovery units and to provide for movement, dispersal, and gene flow) if they become so widespread and dense that they reduce the ability of desert tortoises to forage over wide areas. This threat is most prominent in the action area where fires have the potential to alter habitat conditions on a large scale.

As we discussed in the Status of Critical Habitat of the Desert Tortoise section of this biological opinion, the function and value of the second primary constituent element (sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species) have been compromised to some degree throughout the range of the desert tortoise. The Air Force's activities, particularly near targets where fires are more likely, may exacerbate this threat.

The spread of non-native plant species is not likely to affect the third and fourth primary constituent element (suitable substrates for burrowing, nesting, and overwintering; burrows, caliche caves, and other shelter sites). We have reached this conclusion because the plants would not generally affect substrates or shelter sites used by desert tortoises.

Non-native plant species can degrade vegetation that desert tortoises use to seek shelter from temperature extremes and predators (the fifth primary constituent element), primarily by supporting larger and more intense fires. Most shrubs in the California desert are not adapted to fire. Once fire kills these shrubs, they are unlikely to return, thus depriving desert tortoises of shelter sites.

Habitat that is degraded by the presence of a large component of non-native species has not been protected from disturbance and human-caused mortality (the sixth primary constituent element). Consequently, spread of non-native plant species has the potential to further degrade the value and function of this primary constituent element.

As we discussed in the Status of the Desert Tortoise section of this biological opinion, current information indicates that invasive species likely affect a large portion of the desert tortoise's range. Non-native species can occur in densities that can increase the risk of fires, which, in turn, destroy native species and may result in future habitat loss. Non-native plant species currently occur throughout Edwards Air Force Base (see Appendix B in 2008b). The Air Force's wildland fire management plan (Appendix H in Air Force 2008b) has potential to reduce the spread of non-native plant species by implementing effective suppression of wildland fires and minimizing fire and structural damage to biological resources. In the event of a wildfire that may affect desert tortoises or their critical habitat, the Air Force and Service would consult under the emergency provisions of section 7(a)(2) of the Endangered Species Act.

Common Ravens

Desert Tortoise

The Air Force has proposed to manage its trash and debris to reduce the attractiveness of Edwards Air Force Base to common ravens. This protective measure would likely be effective in reducing some level of food subsidies to common ravens. We expect that buildings and other structures on the Edwards Air Force Base would continue to provide common ravens with more perching, roosting, and nesting sites than would be found in a natural setting. We also expect that common ravens also derive at least some food and water from the residential area of the installation. Future development may lead to an increase in the number of people using the residential area, which may, in turn, increase the amount of food and water available to common ravens. Any increase in the number of common ravens would likely result in increased predation of desert tortoises.

Critical Habitat

Common ravens do not affect the primary constituent element of critical habitat.

Moving Desert Tortoises from Harm's Way

Desert Tortoise

Some potential exists that capturing desert tortoises to move them from harm's way may cause elevated levels of stress that may render these animals more susceptible to disease. Because the Air Force will use experienced biologists approved by the Service and approved handling techniques, collected desert tortoises are unlikely to experience elevated stress levels. Information from a translocation project at Fort Irwin indicates that translocation of desert

tortoises in that study did not cause a measurable physiological stress response (Drake et al. 2012). In the case of Fort Irwin, the animals were often moved far from their home ranges. Because the Air Force's activities are of a smaller scale, desert tortoises moved from harm's way would likely remain within their home ranges; therefore, we expect that the potential for these animals to be stressed is even lower.

Critical Habitat

Moving desert tortoises from harm's way will not affect critical habitat because this activity primarily involves the transport of individuals a relatively short distance by a biologist who is traveling on foot. Neither the desert tortoises themselves nor the personnel who transport them will affect the primary constituent elements of critical habitat. The construction of artificial burrows would disturb limited areas where annual plants could grow and their supporting substrates; however, this disturbance will not measurably affect the value or function of the primary constituent elements of critical habitat.

Personnel on Foot

Desert Tortoise

Because of their small size, hatchlings and slightly larger desert tortoises could be trampled by foot traffic. Nests are also vulnerable, but their typical location, near the mouth of a burrow, likely protects them to some degree.

We expect that few desert tortoises would be injured or killed in this manner because most Air Force personnel working in desert tortoise habitat will receive specific training, which would increase their awareness of this potential threat. Additionally, we expect that the likelihood of stepping on desert tortoises would generally be low because most activities involving personnel on foot would occur in a relatively limited area of the base and most frequently in situations where the Air Force has conducted surveys to protect desert tortoises.

Critical Habitat

This activity will not affect the primary constituent elements of critical habitat because of the general low level and intensity of use.

Habitat Conversion

Desert Tortoise

Various activities that the Air Force may undertake have the potential to cause habitat conversion. The act of converting habitat from an area that is suitable for desert tortoises into some other environment has the potential to kill the individuals living in that area. Generally, the

heavy equipment that is involved in the conversion of habitat would crush any desert tortoises that are present.

As we have discussed previously in this biological opinion, other factors, such as fire and an overabundance of non-native species can, either together or separately, covert an area of suitable habitat for desert tortoises into something that is far less able to support them. Over time, desert tortoises that are forced to live in such areas are likely to die as a result of starvation; prior to that, their reproductive output would likely be lower because of their poorer physiological condition.

Critical Habitat

Suitable habitat generally is that which contains the primary constituent elements of critical habitat in a functioning condition. In the context of critical habitat, habitat conversion would occur when the amount of disturbance or alteration of a primary constituent element removes its function or value. Any ground-based activity that the Air Force undertakes could potentially disturb or alter, to some degree, the primary constituent elements. As examples, the extensive use of off-road vehicles could decrease the amount of space needed to support a viable population of desert tortoises and to provide for movement, dispersal, and gene flow within the Western Mojave Recovery Unit. Vehicles traveling off roads could decrease the quality and quantity of forage species and the substrate conditions that support the growth of these species and for burrowing; off-road travel could also destroy burrows, caliche caves, and other shelter sites and the perennial vegetation that desert tortoises use for shelter from temperature extremes and predators. Off-road vehicle use would increase the amount of disturbance and human-caused mortality in the area in which it occurred.

Future Development

In this biological opinion, we considered future development to be any activity that the Air Force undertakes for which this biological opinion serves as compliance with the Endangered Species Act. Consequently, we consider the future injury or death of any desert tortoise that may result from an otherwise legal activity to have been analyzed in this biological opinion, provided that it is within the parameters proposed by the Air Force. With regard to habitat and critical habitat, we expect the Air Force to track any loss of habitat or critical habitat caused by any otherwise legal activity it conducts or authorizes. Disturbance resulting from activities that occur in previously disturbed areas that do not support the biological or physical attributes of desert tortoise habitat or in undisturbed natural areas that do not support desert tortoise habitat (e.g., dry lake beds) would not be considered to involve the loss of desert tortoise habitat.

Desert Tortoise

The regulatory definition of "to jeopardize the continued existence of the species" focuses on assessing the effects of the proposed action on the reproduction, numbers, or distribution of the species being considered in the biological opinion. For that reason, we have used those aspects

of the desert tortoise's status as the basis to assess the overall effect of the proposed action on the species.

In the first portion of the Effects of the Action section of this biological opinion, we provided a general description of how the various activities that the Air Force expects to undertake are likely to affect desert tortoises. In the following sections, we will use the proposed re-initiation threshold of five desert tortoises killed in a year to determine how the future operation of Edwards Air Force Base would affect the reproduction, number, and distribution of the desert tortoise. We will then assess the effects of the proposed action on the recovery of the species and whether it is likely to appreciably reduce the likelihood of both the survival and recovery of the desert tortoise. We reach our conclusion regarding whether an action is likely "to jeopardize the continued existence of the species" through an analysis of how a proposed action affects the listed taxon within the action area in relation to the range of the entire listed taxon. For the desert tortoise, this process involves considering the effects at the level of the action area, then at the level of the recovery unit (in this case, the Western Mojave Recovery Unit), and then finally for the range of the listed taxon. Logically, if an aspect of the proposed action is unlikely to cause a measurable effect within the action area, it is unlikely to affect the recovery unit or the remainder of the range.

Reproduction

The reproductive output of individuals of a species is determined in part by the species' breeding ecology, overall abundance of breeding individuals, and the condition of the habitat in which they live. The reproductive output of the desert tortoise is governed by several aspects of its breeding ecology: the delayed onset of breeding, many years of reproduction, high mortality rates of eggs and young, and low mortality rates among adults. If the population of desert tortoises at Edwards Air Force Base was stable or increasing, the loss of five individuals per year to human activities would be unlikely to have a measurable effect on its overall reproductive capacity. The long reproductive life of female desert tortoises and the normally low mortality rates among adult animals are factors that would protect the reproductive output of a population.

The overall abundance of breeding individuals would also influence how the loss of five desert tortoises per year affects their reproductive output at Edwards Air Force Base. In general, desert tortoises occur at low densities in most areas of the base; the highest density is 58 desert tortoises over one square mile. In some areas, their densities are extremely low. The effects of the mortality of five desert tortoises per year within Edwards Air Force Base may negatively affect the amount of reproduction for several reasons. First, the loss of even a small number of individuals in a low-density population could render finding mates more difficult. Second, desert tortoises require from 13 to 20 years to reach sexual maturity. Third, females produce a relatively small number of eggs per year. Fourth, desert tortoises also experience high mortality early in life (including as eggs). Consequently, even moderate downward fluctuations in adult survival rates can result in rapid population declines; slow reproductive rates and high juvenile mortality limit the capacity of populations to increase rapidly after a decline (Service 2011a).

The desert tortoise possesses two safeguards against the loss of reproduction in areas of low population density. First, female desert tortoises can store sperm for several years; this trait provides some hedge against low densities precluding reproduction because females do not need to encounter males every year to produce young. Second, breeding-age desert tortoises would continue to produce young over their long reproductive life; this reproductive output could replace individuals that are killed by the Air Force's activities.

The amount and timing of rainfall in the desert greatly influences the production of native annual plants upon which desert tortoises feed. A high diversity and abundance of annual plants provide desert tortoises with the appropriate quality and quantity of food to persist and to produce eggs. The widespread invasion of non-native annual plants has likely reduced the desert tortoise's ability to obtain the appropriate quality and quantity of forage plants on a consistent basis. Human disturbance of substrates and increased frequency of fires render desert habitat more susceptible to invasion by non-native annual plants. The Air Force does not implement specific measures to control weed infestations that its activities may cause. Consequently the Air Force's activities have the potential to indirectly affect desert tortoise habitat well outside the footprint of areas that it directly disturbs. Some potential exists that non-native plants are already established at Edwards Air Force Base to the degree that the Air Force's activities would not exacerbate the situation. If the Air Force introduced new species of invasive plants during its activities or expanded the area of infestation of invasive species already on base, the quality of desert tortoise habitat would likely further decrease; such a decrease would negatively affect the ability of Edwards Air Force Base to support the reproduction of desert tortoises at the highest levels of productivity.

Based on these factors, we conclude that the loss of five individuals per year to the Air Force's activities is likely to cause a minor depression of reproduction of desert tortoises at Edwards Air Force Base. We acknowledge that all five individuals may not be of reproductive age; the loss of non-reproductive individuals would not have an immediate effect on reproduction. We also acknowledge that the loss of younger animals would reduce their potential recruitment into breeding age individuals.

Our determination with regard to whether a proposed action is likely to jeopardize the continued existence of a species is based on the status of the listed taxon throughout its range and not just within the action area. Consequently, although the loss of five desert tortoises per year at Edwards Air Force Base is likely to cause a minor depression of reproduction of desert tortoises at Edwards Air Force Base, this loss is unlikely to have a measurable effect on the reproduction of desert tortoises within the Western Mojave Recovery Unit or range wide. We have reached this conclusion because Edwards Air Force Base comprises a small portion of the Western Mojave Recovery Unit and an even smaller portion of the species' range. The next section of this analysis provides insight into the numbers of desert tortoises within Edwards Air Force Base, the Western Mojave Recovery Unit, and range wide.

Number

We used the reports on range-wide sampling for the last 3 years (Service 2012b, 2012c, 2012d) to assess how the loss of 5 individuals per year at Edwards Air Force Base would affect the desert tortoise, first within the Western Mojave Recovery Unit (which is where Edwards Air Force Base is located) and then throughout its range. The numbers in the following table are desert tortoises that are greater than 180 millimeters in length that reside in the sampled areas of critical habitat and other desert tortoise conservation areas; because these numbers do not include smaller individuals and desert tortoises that reside outside the sampled areas, we expect that more desert tortoises occur in the Western Mojave Recovery Unit and throughout the range than are represented in this table. Because of the complexity involved with sampling desert tortoises on such a large scale, the changes in numbers from year to year are more likely from sampling error than actual trends or changes in the number of individuals.

Year	Area of Estimate	Number of Desert Tortoises		
		Estimated	Lower 95 Percent CI	Upper 95 Percent CI
2010	Western Mojave	20,264	13,153	31,329
	Range-wide	95,145	77,038	117,511
2011	Western Mojave	21,533	12,600	37,120
	Range-wide	99,568	69,324	143,007
2012	Western Mojave	22,260	19,894	46,735
	Range-wide	71,827	46,685	110,509

To assume the most conservative approach to this analysis, we assumed that the actual numbers of desert tortoises in the Western Mojave Recovery Unit and range wide were the lowest results from these 3 years (12,600 and 46,685). We also assumed that all five desert tortoises that die would be reproductive. These losses amount to approximately 0.04 and 0.01 percent of the number of desert tortoises over 180 millimeters within sampled areas in Western Mojave Recovery Unit and throughout the range; these percentages would decrease even further if we considered all desert tortoises through the entire recovery unit and range.

Because the Air Force's activities would continue over time, we also calculated how the loss of five individuals over a 20-year period would affect desert tortoise populations. The loss of 100 desert tortoises would comprise approximately 0.79 and 0.21 percent of the Western Mojave Recovery Unit and range-wide populations, respectively.

We acknowledge that we cannot predict whether the numbers of desert tortoises at Edwards Air Force Base, within the Western Mojave Recovery Unit, or range wide would change over the next 20 years. If the number of desert tortoises at Edwards Air Force Base decreases, we expect that the Air Force would encounter fewer individuals while it is implementing actions and, therefore, fewer individuals are likelier to die. If more desert tortoises number occur at Edwards Air Force Base in the future, the risk that desert tortoises would die at any given project would increase but the Air Force's proposed protective measures (including a commitment to re-initiate

formal consultation if five are killed in a year) would prevent an appreciable increase in mortalities.

Consequently, based on the best available information, we conclude that the loss of five desert tortoises per year is not likely to appreciably diminish the number of desert tortoises, either within the Western Mojave Recovery Unit or range wide.
We did not discuss the injury of desert tortoises in this section. The implementing regulations for section 7 of the Endangered Species Act at 50 Code of Federal Regulations 402.14(i)(1)(iv) require the Service to specify the procedures to be used to handle or dispose of any individuals of a species that is killed or injured during the implementation of a proposed action that has undergone formal consultation. Consequently, in the Incidental Take Statement - Disposition of Dead or Injured Specimens section of this biological opinion, we will direct the Air Force to take injured desert tortoises to a qualified veterinarian for treatment and to contact us regarding the final disposition any these animals. If they recover from their injuries to the extent that they can be released to the wild, these animals would not be included in the annual count of dead desert tortoises.

Distribution

Edwards Air Force Base occupies approximately 307,516 acres. Of this total, areas of unsuitable habitat (e.g., Buckhorn, Rogers, and Rosamond dry lakes), cantonment areas; research facilities, fenced operational areas, graded targets, other operational areas, and housing cover approximately 80,640 acres. Consequently, approximately 226,876 acres of desert tortoise habitat occur on base.

The Air Force has proposed to re-initiate formal consultation if 20,000 acres of desert tortoise habitat (15,000 acres outside of critical habitat boundaries and 5,000 within the boundaries of critical habitat) are disturbed by future development. This amount of long-term disturbance would comprise up to approximately 9.09 percent of the desert tortoise habitat on Edwards Air Force Base. Previous consultations with the Air Force generally involved numerous actions that affected scattered, relatively small areas of desert tortoise habitat across Edwards Air Force Base. We expect this general pattern to continue. One exception is the Air Force's proposal to allow for the development and operation of a large solar plant in the northwest corner of Edwards Air Force Base. This solar plant may occupy up to 4,000 acres. We do not have information on the final design of the plant at this time; however, some potential exists that the Air Force and operator would not exclude desert tortoises from the entire project area during its operation.

This future development, including the solar plant in the northwestern corner of the base, would reduce the amount of habitat on base and increase, to some degree, the amount of fragmentation on a local scale. Based on the Nussear et al. (2009, using values of 0.5 to 1) model and our calculations (Waln 2010), the Western Mojave Recovery Unit may support up to 10,316 square miles of desert tortoise habitat. Consequently, the proposed action would result in the loss of approximately 0.30 percent of the habitat in the Western Mojave Recovery Unit. (That is,

20,000 acres of disturbance divided by 640 acres per square mile equals 31.25 square miles. 31.25 square miles divided by 10,316 square miles equals 0.00302. 0.00302 multiplied by 100 equals 0.30 percent.) Because the area that may be disturbed at Edwards Air Force Base is a small proportion of the available habitat in the Western Mojave Recovery Unit and because most of the projects that the Air Force undertakes would be relatively small and scattered throughout

the base, we do not expect this loss of habitat to appreciably reduce the distribution of the desert tortoise with regard to the Western Mojave Recovery Unit.

This loss would comprise approximately 0.11 percent of the range-wide distribution of the desert tortoise, which covers approximately 28,417 square miles, using the values of 0.5 to 1 in the Nussear et al. (2009) model and our calculations (Waln 2010). (That is, 31.25 square miles of disturbance divided by 28,417 square miles equals 0.00109. 0.00109 multiplied by 100 equals 0.11 percent.) This loss of habitat is unlikely to appreciably reduce the distribution of the desert tortoise in relation to the range of the listed taxon.

Critical Habitat

We have previously discussed how the various aspects of the Air Force's activities would affect the primary constituent elements of critical habitat, so we will not repeat those analyses here. For the purposes of this analysis, we will assume that any future development within critical habitat is likely to reduce or eliminate the function of the primary constituent elements within the boundaries of that project's area; in terms of the analysis, this assumption likely overstates the effect because some of the primary constituent elements would likely remain after the implementation of at least some of the future actions.

The Air Force anticipates that it may need up to 5,000 acres for the development of new facilities, infrastructure, and new or expanded targets within the approximately 60,800 acres of critical habitat that lie within Edwards Air Force Base. Future development would likely be scattered throughout critical habitat in variously sized parcels. We expect that the Air Force is unlikely to situate larger developments within critical habitat because larger facilities would require more infrastructure support and most of the existing infrastructure is located outside of critical habitat.

The loss or disturbance of 5,000 acres of critical habitat during future development and operations of Edwards Air Force Base has the potential to increase the patchiness of suitable habitat because it could occur in numerous locations. Conversely, we do not expect that scattered development throughout the area of critical habitat within Edwards Air Force Base would measurably affect connectivity, either within or outside of the base. This amount of disturbance would also occupy a relatively small area of the critical habitat on base.

The 5,000 acres comprise approximately 0.96 percent of the Fremont-Kramer Critical Habitat Unit. (That is, 5,000 acres of development divided by 518,000 acres of critical habitat within the Fremont-Kramer Critical Habitat Unit times 100 equals 0.96 percent.) The Service must

consider the effects of a proposed action with regard to the entirety of the 6,446,200 acres of critical habitat that it designated. The 5,000 acres that may be lost or disturbed at Edwards Air Force Base comprise approximately 0.08 percent of critical habitat throughout the range. Because the amount of critical habitat to be lost or disturbed is so small relative to the entire designated area, it is not likely to appreciably diminish the value or function of critical habitat.

Effects on Recovery

Edwards Air Force Base occupies a relatively small portion of the Western Mojave Recovery Unit and an even smaller portion of the range of the desert tortoise. Consequently, the activities that the Air Force conducts on base under consideration in this biological opinion are unlikely to have an appreciable direct effect, either positively or negatively, on the recovery of the desert tortoise. The relatively small number of desert tortoises that we expect the Air Force to kill annually is unlikely to appreciably diminish the ability of the desert tortoise to reach stable or increasing population trends in the future. The Air Force's efforts to re-vegetate disturbed areas, close unneeded roads and unused excavations to reduce mortality of desert tortoises, and install exclusion fence and warning signs along roads to reduce mortality on active roads are likely to promote the conservation of the species within Edwards Air Force Base.

We do not consider the maintenance of head starting pens to raise desert tortoises for release to the wild to be an effective tool for recovery of the species at this time. Mortality rates among wild desert tortoises likely remain too high for desert tortoises released from head-starting pens to result in an expanded population; we also suspect that recruitment of reproductive animals from the ranks of juvenile desert tortoises is not occurring at a sustainable rate in at least some areas of the desert. Various studies have shown that protection of reproductive desert tortoises would contribute far more to the stabilization of population trends than the release of smaller individuals. Until we can improve the survival rate of reproductive desert tortoises (and rate of recruitment of juveniles to a reproductive size), the practice of head starting is highly unlikely to affect an increase in wild populations.

The Readiness and Environmental Protection Initiative would implement an important recovery task for the desert tortoise through the Air Force's acquisition in fee title or by easement lands with critical habitat that lie to the east of the base. These acquisitions would preclude the development of the land; such development is generally detrimental, both directly and indirectly, to the long-term conservation of the desert tortoise.

Overall, the operation of Edwards Air Force Base, as described in this biological opinion, including the development of solar energy facilities, is unlikely to adversely affect the recovery of the desert tortoise. We expect the adverse effects of the Air Force's operations to be relatively minor in relation to the range-wide status of the desert tortoise; the Air Force's on-base programs to restore habitat and reduce the mortality of desert tortoises have the potential to offset, to some degree, the adverse effects of its operations. If the Readiness and Environmental Protection Initiative is successfully implemented over time, the removal of the threat of development on

lands important to the long-term conservation of the desert tortoise would constitute an overall positive effect on recovery.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act. Most of the action area is entirely located within Edwards Air Force Base and is therefore on Federal lands; any future actions will be subject to the consultation requirements of section 7(a)(2) of the Act. A small portion of the action area extends from the northwestern corner of Edwards Air Force Base to the Windhub Substation on Oak Creek Road. We are unaware of any non-federal actions that are reasonably certain to occur in this area. Consequently, the proposed action has no associated cumulative effects.

CONCLUSION

Desert Tortoise

After reviewing its current status, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the desert tortoise. We have reached this conclusion for the following reasons. First, the Air Force has proposed measures to reduce the number of desert tortoises that are likely to be injured or killed in the course of its activities. Second, the few desert tortoises that the Air Force is likely to kill is a minor fraction of the number of desert tortoises range-wide; the loss of these animals is unlikely to measurably affect the number of desert tortoises or reproductive capacity of the listed taxon. Third, the Air Force's efforts to reduce hazards to desert tortoises (e.g., fencing roads and closing excavation in which they can become trapped) are likely to reduce the level of ongoing mortality on base. Fourth, the loss of habitat that is likely to occur during future activities at Edwards Air Force Base will not appreciably reduce the distribution of the desert tortoise.

Critical Habitat of the Desert Tortoise

After reviewing the current status of critical habitat, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the proposed action is not likely to result in the destruction or adverse modification of critical habitat of the desert tortoise. We have reached this conclusion because the amount of critical habitat that is likely to be affected comprises a small portion of the total amount of the critical habitat on Edwards Air Force Base, which itself is a small portion of the larger Fremont-Kramer Critical Habitat Unit and an even smaller portion of critical habitat range wide. Therefore, the amount of disturbance is not likely to compromise the conservation function and value of critical habitat for the desert tortoise.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened wildlife species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to, and not the purpose of, the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this incidental take statement and the avoidance and minimization measures proposed by the Air Force.

The measures described below are non-discretionary; the Air Force must implement these measures during the conduct of its activities or include them as binding conditions of any grant or permit issued to its customers and contractors, as appropriate, for the exemption in section 7(o)(2) to apply. The Air Force has a continuing duty to regulate the activity covered by this incidental take statement. If the Air Force fails to assume and implement the terms and conditions or fails to require its customers and contractors to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. To monitor the impact of incidental take, the Air Force must report the progress of the actions and its impact on the species to the Service as specified in the incidental take statement (50 Code of Federal Regulations 402.14(i)(3)).

The Service anticipates that five desert tortoises per year are likely to be taken, in the form of mortality, as a result of the operation of Edwards Air Force Base. We derived this number through discussions with the Air Force and used it as the basis of our section 7(a)(2) analysis in this biological opinion. This number also serves as a basis for the re-initiation of formal consultation.

We do not expect removing desert tortoises from harm's way during the implementation of the Air Force's activities to result in their injury or mortality. Therefore, we are not including an anticipated amount or extent of this form of take (i.e., capture).

REASONABLE AND PRUDENT MEASURES AND TERMS AND CONDITIONS

The Air Force and Service agreed to several revisions to the proposed action during the course of formal consultation. Because these revisions have been incorporated into the proposed action of

this biological opinion, we have no additional reasonable and prudent measures or terms and conditions.

As described at the beginning of this section, the protective coverage of section 7(o)(2) may lapse if the Air Force does not abide by the protective measures described in this biological opinion. Additionally, the Air Force remains responsible for complying with the provisions of

Reporting Requirements and Disposition of Dead or Injured Specimens sections of this biological opinion.

REPORTING REQUIREMENTS

Pursuant to 50 Code of Federal Regulations 402.14(i)(3), the Air Force must provide a report to the Service that provides details on each desert tortoise that is killed or injured by its activities. In addition to the information that the Air Force will provide to the Service in its annual report, as described in the Administration of the Consultation section of this biological opinion, the report must also include information on any instances when desert tortoises were killed, injured, or handled, the circumstances of such incidents, and any actions undertaken to prevent similar instances from re-occurring. The report must also include a description of the monitoring efforts that occurred during implementation of actions that occur with desert tortoise habitat.

DISPOSITION OF DEAD OR INJURED SPECIMENS

Within 3 days of locating any dead or injured desert tortoises, the Air Force must notify the Ventura Fish and Wildlife Office by telephone (805 644-1766) and by facsimile or electronic mail. The report must include the date, time, and location of the carcass, a photograph, cause of death, if known, and any other pertinent information.

The Air Force must take any injured desert tortoises to a qualified veterinarian for treatment. If any injured desert tortoises survive, the Air Force must contact the Service regarding their final disposition.

Care must be taken in handling dead specimens to preserve biological material in the best possible state for later analysis, if such analysis is needed. The Service will make this determination when the Air Force provides notice that a desert tortoise has been killed by project activities.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The Service recognizes the effort that the Air Force's undertakes to conserve desert tortoises and their habitat. To meet its obligations under section 7(a)(1) of the Act, the Air Force has implemented several actions. For example, the Air Force has provided funds or personnel to conduct line-distance sampling within the Fremont-Kramer Critical Habitat Unit; the data generated by this sampling effort assists the Service in determining population trends across the range of the desert tortoise.

The Air Force is also working in conjunction with nongovernment conservation organizations to acquire lands through the Readiness and Environmental Protection Initiative program. This program supports cost-sharing partnerships authorized by Congress between the military, private conservation groups, and state and local governments to protect military test and training capabilities and conserve land. In the case of Edwards Air Force Base, the Air Force's goal of maintaining open space under the test flight corridors to the north of the base coincides with the Service's goal of conserving critical habitat of the desert tortoise.

The Air Force plans to continue to close and rehabilitate off-highway vehicle routes near the base and within the Fremont-Kramer Critical Habitat Unit to protect regional desert tortoise populations. Within Edwards Air Force Base, the Air Force plans to continue efforts to install desert tortoise barrier fencing and culverts along heavily traveled roads crossing desert tortoise habitat. The Air Force will prioritize the fencing of areas with high densities of desert tortoises or critical habitat; implementation of these actions is contingent upon available funding. To date, the Air Force has installed approximately 13 miles of desert tortoise exclusionary fencing along roads within Edwards Air Force Base.

In addition to these actions, we also recommend that the Air Force:

1. Assist the Service in implementation of the management plan for the common raven, control of feral dogs, management of subsidies for coyotes (*Canis latrans*), and numerous other activities that are intended to reduce the mortality levels of desert tortoises and improve habitat conditions.

2. Mark small desert tortoises from within project sites prior to their movement from harm's way or translocation. This marking would provide some information on their post-project status if they are encountered during future surveys or monitoring efforts. If the Air Force determines that it will include this requirement, we suggest that the authorized biologist contact the Desert Tortoise Recovery Office to ascertain the most appropriate means of marking the animals.

The Service requests notification of the implementation of any conservation recommendations so we may be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats.

RE-INITIATION NOTICE

This concludes formal consultation on operations at Edwards Air Force Base. As provided in 50 CFR 402.16, re-initiation of formal consultation is required where discretionary Federal involvement or control over the action has been retained or is authorized by law and: (1) if the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, the exemption issued pursuant to section 7(o)(2) will have lapsed and any further take would be a violation of section 4(d) or 9. Consequently, we recommend that any operations causing such take cease pending re-initiation.

If you have any questions, please contact Rachel Henry or Ray Bransfield of my staff at (805) 644-1766, extension 333 and 317.

Sincerely,

Stephen P. Henry

Stephen P. Henry
Acting Field Supervisor

Appendices

1. Mojave population of the desert tortoise (*Gopherus agassizii*). 5-year review: summary and evaluation. Available on disk or hard copy by request or at http://ecos.fws.gov/docs/five_year_review/doc3572.DT%205Year%20Review_FINAL.pdf.
2. Solar projects for which the U.S. Fish and Wildlife Service has issued biological opinions or incidental take permits.

References Cited

Allison, L. 2013. Electronic mail. Range-wide population trends. Dated September 9. Desert tortoise monitoring coordinator, Desert Tortoise Recovery Office, U.S. Fish and Wildlife Service. Reno, Nevada.

Bowles, A.E., S. Eckert, L. Starke, E. Berg, L. Wolski, and J. Matesic, Jr. 1999. Effects of flight noise from jet aircraft and sonic booms on hearing, behavior, heart rate, and oxygen consumption of desert tortoises (Gopherus agassizii). Sea World Research Institute, Hubbs Marine Research Center. San Diego, California.

Brewer-Anderson, A. 2013. Electronic mail. Description of the gen-tie line for the Oro Verde Solar Project. Dated December 12. Program Manager, Edwards Air Force Base. Edwards Air Force Base, California.

Bureau of Land Management, County of San Bernardino, and City of Barstow. 2005. Final environmental impact report and statement for the West Mojave Plan; a habitat conservation plan and California Desert Conservation Area Plan amendment. California Desert District, Moreno Valley, California.

Desert Tortoise Recovery Office. 2014. Internal document. Update on monitoring. Dated January 14. U.S. Fish and Wildlife Service. Reno, Nevada.

Drake, K.K., K.E. Nussear, T.C. Esque, A.M. Barber, K.M. Vittum, P.A. Medica, C.R. Tracy, and K.W. Hunter. 2012. Does translocation influence physiological stress in the desert tortoise? Animal Conservation doi:10.1111/j.1469-1795.2012.00549.x.

Esque, T.C., K.E. Nussear, K.K. Drake, A.D. Walde, K.H. Berry, R.C. Averill-Murray, A.P. Woodman, W.I. Boarman, P.A. Medica, J. Mack, J.S. Heaton. 2010. Effects of subsidized predators, resource variability, and human population density on desert tortoise populations in the Mojave Desert, USA. Endangered Species Research 12(2):167-177.

Fort Irwin Research Coordination Meeting. 2008. Meeting notes. Dated October 29.

Hoff, K.V., and R.W. Marlow. 2002. Impacts of vehicle road traffic on desert tortoise populations with consideration of conservation of tortoise habitat in southern Nevada. Chelonian Conservation and Biology 4:449-456.

Ironwood Consulting. 2011. Biological resources technical report – Stateline Solar Farm Project, San Bernardino County, California. Redlands, California.

Longshore, K.M., J.R Jaeger, and M. Sappington. 2003. Desert tortoise (Gopherus agassizii) survival at two eastern Mojave desert sites: death by short-term drought? Journal of Herpetology 37(1):169-177.

McLuckie, A.M., P.G. Emblidge, and R.A. Fridell. 2010. Regional desert tortoise monitoring in the Red Cliffs Desert Reserve, 2009. Publication Number 10-13. Utah Division of Wildlife Resources. Salt Lake City, Utah.

Mull, T. 2013a. Electronic mail regarding re-initiation threshold for the programmatic biological opinion. Dated December 9. Conservation support, Edwards Air Force Base, California.

Mull, T. 2013b. Electronic mail regarding desert tortoise exclusionary fencing currently installed on base. Dated September 5. Conservation support, Edwards Air Force Base, California.

Mull, T. 2013c. Electronic mail regarding desert tortoise mortalities. Dated November 4. Conservation support, Edwards Air Force Base, California.

Mull, T. 2013d. Electronic mail providing acres of disturbance reported for past biological opinions. Dated July 31. Conservation support, Edwards Air Force Base, California.

Nussear, K.E., T.C. Esque, R.D. Inman, L. Gass, K.A. Thomas, C.S.A. Wallace, J.B. Blainey, D.M. Miller, and R.H.Webb. 2009. Modeling habitat of the desert tortoise (Gopherus agassizii) in the Mojave and parts of the Sonoran Deserts of California, Nevada, Utah, and Arizona. U.S. Geological Survey Open-File Report 2009-1102.

Oftedal, O.T., S. Hillard, and D.J. Morafka. 2002. Selective spring foraging by juvenile desert tortoises (Gopherus agassizii) in the Mojave Desert: evidence of an adaptive nutritional strategy. Chelonian Conservation and Biology 4(2):341-352.

Reinke, Dan. 2009. Electronic mail regarding consultation on basewide desert tortoise biological opinion. Dated September 24. Edwards Air Force Base, California.

Reinke, Dan. 2013. Electronic mail regarding measuring restoration efforts. Dated September 3. Edwards Air Force Base, California.

Tracy, C.R., R. Averill-Murray, W.I. Boarman, D. Delehanty, J. Heaton, E. McCoy, D. Morafka, K. Nussear, B. Hagerty, and P. Medica. 2004. Desert Tortoise Recovery Plan Assessment. Prepared for the U.S. Fish and Wildlife Service. Reno, Nevada.

U.S. Air Force. 1994. Edwards Air Force Base revegetation plan. Dated December. Air Force Flight Test Center, Environmental Management Office, Edwards Air Force Base, California.

U.S. Air Force. 2008a. Biological evaluation for the desert tortoise (Gopherus agassizii) for operations and activities at Edwards Air Force Base, California. Dated February. Edwards Air Force Base, California.

U.S. Air Force. 2008b. Integrated natural resources management plan for Edwards Air Force Base, California. Dated August. Edwards Air Force Base, California.

U.S. Air Force. 2010. Desert tortoise relative density estimates at Edwards Air Force Base, California. Dated March. Prepared by Air Force Flight Test Center and U.S. Army Corps of Engineers, Edwards Air Force Base and Sacramento, California.

U.S. Air Force. 2012. Comprehensive base-wide habitat restoration plan. Dated May. Environmental Management Office, Edwards Air Force Base, California.

U.S. Air Force. 2014a. Geographical Information System database: revegetation data of burn sites on Edwards Air Force Base. Environmental Management Office, Edwards Air Force Base, California.

U.S. Air Force. 2014b. Comments on the draft programmatic biological opinion for operations and activities at Edwards Air Force Base, California (8-8-14-F-14). Dated March 4. Edwards Air Force Base, California.

U.S. Fish and Wildlife Service. 1993a. Draft desert tortoise (Mojave population) recovery plan. Portland, Oregon.

U.S. Fish and Wildlife Service. 1993b. Biological opinion for the proposed maintenance and repair of roads on Edwards Air Force Base, California (1-8-93-F-32). Letter to Colonel Vernon P. Saxon, Jr. Vice Commander, Edwards Air Force Base, California. Dated September 22. From Field Supervisor, Ventura Fish and Wildlife Office. Ventura, California.

U.S. Fish and Wildlife Service. 1994a. Desert tortoise (Mojave population) recovery plan. Portland, Oregon.

U.S. Fish and Wildlife Service. 1994b. Biological opinion for the Precision Impact Range Area, Edwards Air Force Base, California (1-8-94-F-6). Letter to Colonel Vernon P. Saxon, Jr. Vice Commander, Edwards Air Force Base, California. Dated March 10. From Field Supervisor, Ventura Fish and Wildlife Office. Ventura, California.

U.S. Fish and Wildlife Service. 1995. Biological opinion for installation of underground communication lines and related facilities on Edwards Air Force Base, California (1-8-95-F-6). Letter to Colonel Vernon P. Saxon, Jr. Vice Commander, Edwards Air Force Base, California. Dated January 9. From Field Supervisor, Ventura Fish and Wildlife Office. Ventura, California.

U.S. Fish and Wildlife Service. 1996. Biological opinion on establishment and continued use of an off-road vehicle area at the Air Force Flight Test Center in Kern, Los Angeles and San Bernardino Counties, California (1-8-96-F-10). Letter to Colonel Vernon P. Saxon, Jr. Vice Commander, Edwards Air Force Base, California. Dated March 27. From Field Supervisor, Ventura Fish and Wildlife Office. Ventura, California.

U.S. Fish and Wildlife Service. 2004. Biological opinion for the proposed addition of maneuver training lands at Fort Irwin, California (1-8-03-F-48). Letter to Colonel Edward Flynn,Fort Irwin, California. Dated March 15. From Field Supervisor, Ventura Fish and Wildlife Office. Ventura, California.

U.S. Fish and Wildlife Service. 2008. Environmental assessment to implement a desert tortoise recovery plan task: reduce common raven predation on the desert tortoise. Ventura Fish and Wildlife Office, Ventura, California.

U.S. Fish and Wildlife Service. 2009. Range-wide monitoring of the Mojave population of the desert tortoise: 2007 annual report. Desert Tortoise Recovery Office. Reno, Nevada.

U.S. Fish and Wildlife Service. 2010a. Desert tortoise – authorized biologist and monitor responsibilities and qualifications. http://www.fws.gov/ventura/species_information/protocols_guidelines/docs/dt/DT%20Auth%20Bio%20qualifications%20statement%2010_20_08.pdf

U.S. Fish and Wildlife Service. 2010b. Mojave population of the desert tortoise (Gopherus agassizii) 5-year review: summary and evaluation. Desert Tortoise Recovery Office. Reno, Nevada.

U.S. Fish and Wildlife Service. 2011a. Revised recovery plan for the Mojave population of the desert tortoise (Gopherus agassizii). U.S. Fish and Wildlife Service, Pacific Southwest Region, Sacramento, California. May 2011.

U.S. Fish and Wildlife Service. 2012a. Range-wide monitoring of the Mojave population of the desert tortoise: 2008 and 2009 annual report. Desert Tortoise Recovery Office. Reno, Nevada.

U.S. Fish and Wildlife Service. 2012b. Range-wide monitoring of the Mojave population of the desert tortoise: 2010 annual report. Desert Tortoise Recovery Office. Reno, Nevada.

U.S. Fish and Wildlife Service. 2012c. Draft range-wide monitoring of the Mojave population of the desert tortoise: 2011 annual report. Desert Tortoise Recovery Office. Reno, Nevada.

U.S. Fish and Wildlife Service. 2012d. Draft range-wide monitoring of the Mojave population of the desert tortoise: 2012 annual report. Desert Tortoise Recovery Office. Reno, Nevada.

U.S. Fish and Wildlife Service. 2012e. Biological opinion on the proposed addition of maneuver training lands at Fort Irwin, California (8-8-11-F-38R). Dated April 27. Letter to Chief of Staff, Headquarters, National Training Center and Fort Irwin, Fort Irwin, California. From Field Supervisor, Ventura Fish and Wildlife Office. Ventura, California.

U.S. Fish and Wildlife Service. 2012f. Biological opinion on the land acquisition and airspace establishment to support large-scale Marine Air Ground Task Force live-fire and maneuver training, Twentynine Palms, California (8-8-11-F-65). Dated July 17. Letter to Commanding General, Marine Corps Air Ground Combat Center, Twentynine Palms, California. From Field Supervisor, Ventura Fish and Wildlife Office. Ventura, California.

U.S. Fish and Wildlife Service. 2014. Draft programmatic biological opinion for operations and activities at Edwards Air Force Base, California (8-8-14-F-14). Dated January 30. Letter to Base Civil Engineer, Edwards Air Force Base, California. From Field Supervisor, Ventura Fish and Wildlife Office. Ventura, California.

Waln, K. 2010. GIS calculations: estimate of modeled desert tortoise habitat within the Western Mojave Recovery Unit from the 1994 recovery plan. Dated February 2. Ventura Fish and Wildlife Office. Ventura, California.

Xian, G., C. Homer, and J. Fry. 2009. Updating the 2001 National Landcover Database land cover classification to 2006 by using Landsat imagery change detection methods. Remote Sensing of Environment 113:1133-1147.

Appendix 2. Solar projects for which the U.S. Fish and Wildlife Service has issued biological opinions or incidental take permits.

The following table summarizes information regarding the proposed solar projects that have undergone formal consultation with regard to the desert tortoise. In the Citations column, a single reference indicates that the acres of desert tortoise habitat and number of desert tortoises are estimates from the biological opinion; when the column includes two citations, the first is for the acres of desert tortoise habitat from the biological opinion and the second is for number of desert tortoises that are known to have been translocated or killed during construction.

Project and Recovery Unit	Acres of Desert Tortoise Habitat	Desert Tortoises Estimated[1]	Desert Tortoises Observed[2]	Citations[3]
Eastern Mojave				
Ivanpah Solar Electric Generating System	3,582	1,136	173	Service 2011a, 2013d
Stateline Solar	1,685	94	-	Service 2013a
Silver State North – NV	685	14	4	Service 2010a, Cota 2013
Silver State South – NV	2,427[4]	122[4]	-	Service 2013a
Amargosa Farm Road – NV	4,350	4	-	Burroughs 2012
Western Mojave				
Abengoa Harper Lake	Primarily in abandoned agricultural fields	4	-	Service 2011b
Chevron Lucerne Valley	516	10	-	Service 2010b
Northeastern Mojave				
Nevada Solar One - NV	400	[5]	[5]	Burroughs 2012, 2014
Copper Mountain North - NV	1,400	30[5]	30[5]	Burroughs 2012, 2014
Copper Mountain - NV	380	[5]	[5]	Burroughs 2012, 2014
Moapa K Road Solar - NV	2,141	186	157	Service 2012, Burroughs 2013
Colorado				
Genesis	1,774	8	0	Service 2010c, Fraser 2014
Blythe	6,958	30	-	Service 2010d
Desert Sunlight	4,004	56	7	Service 2011c, Fraser 2014
McCoy	4,533	15	-	Service 2013b
Desert Harvest	1,300	5	-	Service 2013c
Rice	1,368	18	1	Service 2011d, Fraser 2014
Total	37,503	1,732	372	

1. The numbers in this column are not necessarily comparable because the methodologies for estimating the numbers of desert tortoises occasionally vary between projects.
2. This column reflects the numbers of desert tortoises observed within project areas. It includes translocated animals and those that were killed by project activities. Project activities may result in the deaths of more desert tortoises than are found.
3. The first citation in this column is for the biological opinion or incidental take permit and is the source of the information for both acreage and the estimate of the number of desert tortoises. The second is for the number of desert tortoises observed during construction of the project; where only one citation is present, construction has not begun or data are unavailable at this time.
4. These numbers include Southern California Edison's Primm Substation and its ancillary facilities.
5. These projects occurred under the Clark County Multi-species Habitat Conservation Plan; the provisions of the habitat conservation plan do not require the removal of desert tortoises. We estimate that all three projects combined will affect fewer than 30 desert tortoises.

The Service completed consultation on the Calico and Palen projects. The applicant for the Calico project, which was located in the Western Mojave Recovery Unit, has abandoned the project and the Bureau has withdrawn the request for consultation (Bureau 2013). For the Palen project, which is located in the Colorado Desert, BrightSource Energy acquired the project from its former owner and proposed to use power tower technology. The California Energy Commission denied the application but will allow BrightSource Energy to re-apply if it can resolve the issues the California Energy Commission raised. Because of the change in technology, the Bureau re-initiated formal consultation with the Service. As of the March 7, 2014, the Service and Bureau have not completed formal consultation on this project; consequently, we have removed it from the table.

Appendix 2: References Cited

Bureau of Land Management. 2013. Withdrawal of request for re-initiation of consultation for the Calico Solar Project. Dated August 09. Memorandum to Field Supervisor, Ventura Fish and Wildlife Office, Ventura, California. From Deputy State Director, California State Office. Sacramento, California.

Burroughs, M. 2012. Electronic mail. Information on solar projects in desert tortoise habitat in Nevada for which the Service has issued biological opinions. Dated April 26. Fish and Wildlife Biologist, Southern Nevada Field Office, U.S. Fish and Wildlife Service. Las Vegas, Nevada.

Burroughs, M. 2013. Electronic mail. Comments on the draft biological opinion for the Stateline and Silver State Solar South projects, San Bernardino County, California, and Clark County, Nevada (Stateline: 2800(P), CACA-048669, CAD090.01; Silver State South: 6840 (NV-052)) (Stateline: 8-8-13-F-43; Silver State South: 84320-2010-F-0208-R003). Dated September 23. Biologist, Southern Nevada Field Office, U.S. Fish and Wildlife Service. Las Vegas, Nevada.

Burroughs, M. 2014. Electronic mails. Status of solar projects in Nevada. Dated January 27. Biologist, Southern Nevada Field Office, U.S. Fish and Wildlife Service. Las Vegas, Nevada.

Cota, M. 2013. Electronic mail. Comments on the draft biological opinion for the Stateline and Silver State Solar South projects, San Bernardino County, California, and Clark County, Nevada (Stateline: 2800(P), CACA-048669, CAD090.01; Silver State South: 6840 (NV-052)) (Stateline: 8-8-13-F-43; Silver State South: 84320-2010-F-0208-R003). Dated September 18. Wildlife biologist, Pahrump Field Office, Bureau of Land Management. Las Vegas, Nevada.

Davis, D. 2013. Electronic mail. Number of desert tortoises being monitored as control animals for the Ivanpah Solar Electric Generating System. Dated September 9. Senior Compliance Manager, BrightSource Energy, Inc. Oakland, California.

Fraser, J. 2014. Electronic mails. Status of solar projects in Colorado Desert. Dated January 27 and 28. Biologist, Palm Springs Fish and Wildlife Office, U.S. Fish and Wildlife Service. Palm Springs, California.

U.S. Fish and Wildlife Service. 2010a. Formal consultation for the Silver State Solar Project (NextLight Renewable Power, LLC), Clark County, Nevada. File No. 84320-2010-F-0208. Dated September 16. Memorandum to Field Manager, Pahrump Field Office, Bureau of Land Management, Las Vegas, Nevada. From State Supervisor, Nevada Fish and Wildlife Office. Reno, Nevada.

U.S. Fish and Wildlife Service. 2010b. Biological opinion on the Lucerne Valley Chevron Solar Project, San Bernardino County, California (8-8-10-F-6). Memorandum to Field Manager, Barstow Field Office, Bureau of Land Management, Barstow, California. Dated June 10. From Field Supervisor, Ventura Fish and Wildlife Office. Ventura, California.

U.S. Fish and Wildlife Service. 2010c. Biological opinion on the Genesis Solar Energy Project, Riverside County, California. Memorandum to Field Manager, Palm Springs South Coast Field Office, Bureau of Land Management, Palm Springs, California. Dated November 2. From Field Supervisor, Carlsbad Fish and Wildlife Office. Carlsbad, California.

U.S. Fish and Wildlife Service. 2010d. Biological opinion on the Blythe Solar Power Plant, Riverside County, California. Memorandum to Field Manager, Palm Springs South Coast Field Office, Bureau of Land Management, Palm Springs, California. Dated October 8. From Field Supervisor, Carlsbad Fish and Wildlife Office. Carlsbad, California.

U.S. Fish and Wildlife Service. 2011a. Biological opinion on BrightSource Energy's Ivanpah Solar Electric Generating System Project, San Bernardino County, California [CACA-48668, 49502, 49503, 49504] (8-8-10-F-24R). Dated June 10. Memorandum to District Manager, California Desert District, Bureau of Land Management, Moreno Valley, California. From Field Supervisor, Ventura Fish and Wildlife Office. Ventura, California.

U.S. Fish and Wildlife Service. 2011b. Biological opinion on the Mojave Solar, LLC's Mojave Solar Project, San Bernardino County, California (8-8-11-F-3). Letter sent to Director of Environmental Compliance, Loan Guarantee Program, Department of Energy, Washington, D.C. and Field Manager, Barstow Field Office, Bureau of Land Management, Barstow, California. Dated March 17. From Field Supervisor, Ventura Fish and Wildlife Office. Ventura, California.

U.S. Fish and Wildlife Service. 2011c. Biological opinion on the Desert Sunlight Solar Farm Project, Riverside County, California. Memorandum to Field Manager, Palm Springs South Coast Field Office, Bureau of Land Management, Palm Springs, California. Dated July 6. From Field Supervisor, Carlsbad Fish and Wildlife Office. Carlsbad, California

U.S. Fish and Wildlife Service. 2011d. Biological opinion on the Rice Solar Energy Project, Riverside County, California. Dated July 27. Letter to John Holt, Environmental Manager, Desert Southwest Customer Service Region Western Area Power Administration, Phoenix, Arizona. From Jim A. Bartel, Field Supervisor, Carlsbad Fish and Wildlife Office. Carlsbad, California.

U.S. Fish and Wildlife Service. 2012. Biological opinion for the K Road Moapa Solar Project, Moapa River Indian Reservation, Clark County, Nevada. Memorandum to Superintendent, Southern Paiute Agency, Bureau of Indian Affairs. St. George, Utah. Dated March 7. From State Supervisor, Nevada Fish and Wildlife Office. Reno, Nevada.

U.S. Fish and Wildlife Service. 2013a. Biological opinion for the Stateline Solar and Silver State Solar South Projects, San Bernardino County, California, and Clark County, Nevada. Dated September 30. Memorandum to Field Manager, Needles Field Office, Bureau of Land Management, Needles California, and Assistant Field Manager, Las Vegas Field Office, Bureau of Land Management, Las Vegas, Nevada. From Acting Field Supervisor, Ventura Fish and Wildlife Office. Ventura, California.

U.S. Fish and Wildlife Service. 2013b. Biological opinion on the McCoy Solar Power Project, Riverside County, California. Dated March 6. Memorandum to Field Manager, California Desert District Office, Bureau of Land Management, Moreno Valley, California. From Field Supervisor, Carlsbad Fish and Wildlife Office. Carlsbad, California.

U.S. Fish and Wildlife Service. 2013c. Biological opinion on the Desert Harvest Solar Project, Riverside County, California [CACA 044919]. Dated January 15. Memorandum to Field Manager, Palm Springs-South Coast Field Office, Bureau of Land Management, Moreno Valley, California. From Field Supervisor, Carlsbad Fish and Wildlife Office. Carlsbad, California.

U.S. Fish and Wildlife Service. 2013d. Internal briefing for the Secretary of the Interior regarding the Ivanpah Solar Electric Generating System. Dated June 25. Ventura Fish and Wildlife Office. Ventura, California